NATIONAL NUCLEAR ENERGY SERIES
Manhattan Project Technical Section

Division IV—Plutonium Project Record
Volume 22 I

HISTOPATHOLOGY OF IRRADIATION

FROM EXTERNAL AND INTERNAL SOURCES

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HISTOPATHOLOGY OF IRRADIATION

FROM EXTERNAL AND INTERNAL SOURCES

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HISTOPATHOLOGY OF IRRADIATION

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By
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Ann Arbor Michigan

FOREWORD

The United States program of development of atomic energy has been described by Major General L R Groves, who, as Commanding General of the War Department's Manhattan Project, directed the program from mid-1942 until December 31, 1946, as "a generation of scientific development compressed into three years" The tremendous scope of the Manhattan Project Technical Section of the National Nuclear Energy Series, which has been in preparation since 1944, is a tribute to the unprecedented accomplishments of science, industry, government, labor, and the Army and Navy working together as a team These volumes can be a firm foundation for the United States atomic energy program which, in the words of the Atomic Energy Act of 1946, is " directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace "

David E Lilienthal, Chairman
U. S Atomic Energy Commission

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PREFACE

This volume is one of a series which has been prepared as a record of the research work done under the Manhattan Project and the Atomic Energy Commission The name Manhattan Project was assigned by the Corps of Engineers, War Department, to the far-flung scientific and engineering activities which had as their objective the utilization of atomic energy for military purposes In the attainment of this objective, there were many developments in scientific and technical fields which are of general interest The National Nuclear Energy Series (Manhattan Project Technical Section) is a record of these scientific and technical contributions, as well as of the developments in these fields which are being sponsored by the Atomic Energy Commission

The declassified portion of the National Nuclear Energy Series, when completed, is expected to consist of some 60 volumes These will be grouped into eight divisions, as follows

Division I — Electromagnetic Separation Project
Division II — Gaseous Diffusion Project
Division III — Special Separations Project
Division IV — Plutonium Project
Division V — Los Alamos Project
Division VI — University of Rochester Project
Division VII — Materials Procurement Project
Division VIII — Manhattan Project

Soon after the close of the war the Manhattan Project was able to give its attention to the preparation of a complete record of the research work accomplished under Project contracts Writing programs were authorized at all laboratories, with the object of obtaining complete coverage of Project results Each major installation was requested to designate one or more representatives to make up a committee, which was first called the Manhattan Project Editorial Advisory Board, and later, after the sponsorship of the Series was assumed by the Atomic Energy Commission, the Project Editorial Advisory Board This group made plans to coordinate the writing programs at all the installations, and acted as an advisory group in all matters affecting the Project-wide writing program Its last meeting was held on Feb 9, 1948, when it recommended the publisher for the Series

ACKNOWLEDGMENT

The Manhattan Project Technical Section of the National Nuclear Energy Series embodies results of work done in the nation's wartime atomic energy program by numerous contractors, including Columbia University. The arrangements for publication of the series volumes were effected by Columbia University, under a contract with the United States Atomic Energy Commission. The Commission, for itself and for the other contractors who contributed to this series, wishes to record here its appreciation of this service of Columbia University in support of the national nuclear energy program.

Many difficulties were encountered in preparing a unified account of Atomic Energy Project work For example, the Project Editorial Advisory Board was the first committee ever organized with representatives from every major installation of the Atomic Energy Project Compartmentation for security was so rigorous during the war that it had been considered necessary to allow a certain amount of duplication of effort rather than to permit unrestricted circulation of research information between certain installations As a result, the writing programs of different installations inevitably overlap markedly in many scientific fields The Editorial Advisory Board has exerted itself to reduce duplication in so far as possible and to eliminate discrepancies in factual data included in the volumes of the NNES In particular, unified Project-wide volumes have been prepared on Uranium Chemistry and on the Analysis of Project Materials Nevertheless, the reader will find many instances of differences in results or conclusions on similar subject matter prepared by different authors This has not seemed wholly undesirable for several reasons First of all, such divergencies are not unnatural and stimulate investigation Second, promptness of publication has seemed more important than the removal of all discrepancies Finally, many Project scientists completed their contributions some time ago and have become engrossed in other activities so that their time has not been available for a detailed review of their work in relation to similar work done at other installations

The completion of the various individual volumes of the Series has also been beset with difficulties Many of the key authors and editors have had important responsibilities in planning the future of atomic energy research Under these circumstances, the completion of this technical series has been delayed longer than its editors wished The volumes are being released in their present form in the interest of presenting the material as promptly as possible to those who can make use of it

The Editorial Advisory Board

The names of the Board members and of the installations which they represented are given below

Atomic Energy Commission	
Public and Technical Information Service	Alberto F Thompson
Technical Information Division, Office of Oak Ridge Directed Operations	Brewer F Boardman
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University of Rochester	D R Charles M J Wantman

* Represented Madison Square Area of the Manhattan District

† The Y-12 plant at Oak Ridge was operated by the Tennessee Eastman Corporation until May 4, 1947, at which time operations were taken over by the Carbide & Carbon Chemicals Corporation

‡ Clinton Laboratories was the former name of the Oak Ridge National Laboratory

¶ SAM (Substitute Alloy Materials) was the code name for the laboratories operated by Columbia University in New York under the direction of Dr H C Urey, where much of the experimental work on isotope separation was done On Feb 1 1945, the administration of these laboratories became the responsibility of Carbide & Carbon Chemicals Corporation Research in progress there was transferred to the K-25 plant at Oak Ridge in June, 1946, and the New York laboratories were then closed

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The Editorial Advisory Board

PLUTONIUM PROJECT RECORD FOREWORD

This report is a technical account of information collected while developing methods for producing plutonium Some of the information deals directly with nuclear physics and chemistry Most of it is related rather to technical processes that needed to be performed in preparation for making the plutonium These publications represent selections from the great mass of current reports, made on the basis of their value to basic science and technology

The current technical reports, written during the war years, were essential to the active work of the plutonium project They supplied needed data and calculations to those who were planning the new processes Selecting from this mass of records the most reliable data and presenting them in a useful form has been an enormous task, for which the writers and editors of these volumes deserve the sincere thanks of their scientific colleagues Many fields of science and technology will develop more rapidly because of this knowledge

The efforts of the men who did this research resulted in the successful production of atomic bombs, which shortened the war and saved the lives of many of their comrades But in the long view of history it is probable that the major human heritage from their work will not be this quick victory It may not even be the useful applications of atomic energy, which was first presented as a Promethean gift to man It is not unlikely that the scientific information in these pages may be the starting point to new reaches of knowledge, which will give to man an understanding that will truly enrich his life

Arthur H Compton

INTRODUCTORY NOTE ON THE PLUTONIUM PROJECT RECORD

Organization and Record of the Metallurgical Project The Plutonium Project Record, which forms Division IV of the National Nuclear Energy Series (NNES) is the scientific and technical record of the former Metallurgical Project The project had its origin in work carried on in 1940-1941, mainly at Columbia and Princeton on the development of the chain-reacting pile and at the University of California at Berkeley on the production and chemistry of transuranic elements In January 1942 this work was concentrated in the newly organized Metallurgical Laboratory at Chicago under the leadership of A H Compton The Metallurgical Project grew out of the Metallurgical Laboratory The initial objectives of the Metallurgical Laboratory were (1) to develop chain-reacting piles to produce plutonium and (2) to develop fission bombs Major associated units were organized in 1942 at Iowa State College at Ames, Iowa (chemistry and metallurgy) under F H Spedding, at the University of California at Berkeley, Calif (chemistry) under W M Latimer and E D Eastman, continuing the previous work there, and at Massachusetts Institute of Technology (metallurgy) under J Chipman and later M Cohen Early in 1943 the work on fission bombs was transferred to an independent project at Los Alamos

After the successful demonstration of a nuclear chain reaction in the West Stands pile at Chicago in December 1942, the Argonne Laboratory with its experimental pile was built west of Chicago, and the Clinton Laboratories with their pilot-plant pile were built at Oak Ridge, Tenn —both in 1943 The three major laboratories at Chicago, Argonne, and Clinton, the associated laboratories at Ames, Berkeley, and M I T , and some seventy other cooperating groups then constituted the Metallurgical Project, under A H Compton as Project Director Closely cooperating in the transition from laboratory and pilot-plant to large-scale operation was E I du Pont de Nemours & Company, which was made responsible for the design and construction of the Clinton pile and for the design, construction, and operation of the Hanford Plutonium Plant The Project continued as such until June 30, 1945, when it was dissolved

The Plutonium Project Record (PPR) covers most of the scientific and technical work of the Metallurgical Laboratory and the Metallurgical Project up to the date of the dissolution of the Project, and also

the continuation of this work in the successor laboratories up to approximately Jan 1, 1946, or in some cases to a later date In addition, the PPR covers in part the pre-1942 work at Columbia, Princeton, and Berkeley The record of the work directly leading up to the Los Alamos Project, however, is omitted Nevertheless the PPR and the Los Alamos Technical Series (Division V of the NNES) cover closely related and in part overlapping subject matter In some of their volumes, particularly in nuclear physics and in chemistry and metallurgy of plutonium

Important phases of the work of the Metallurgical Project that are not reported in the PPR but will be reported elsewhere in the NNES are as follows (1) Division VII, the report of the Materials Procurement Project, includes certain early work on process metallurgy, which was initiated largely by the Metallurgical Laboratory (2) The Division VIII NNES volumes on Analytical Chemistry, which developed from two volumes originally planned as part of the PPR, contain much Metallurgical Project work, including one complete Collected Papers volume (3) The Division VIII NNES volumes on Uranium Chemistry, which were planned and carried out under the supervision of the PPR editorial group, likewise contain much Metallurgical Project work, including one complete Collected Papers volume

History and Plan of the Plutonium Project Record During the war years the scientific and technical work of the Metallurgical Project and its associated laboratories was described currently in a series of reports called the "C reports" The work up to July 1, 1945 was described in some 3,000 reports After that date the Clinton Laboratories reports became a separate series, but reports of the other units of the former Metallurgical Project continued to be issued as C reports Most of the C reports were preliminary or semifinal reports The main consideration during the wartime development was speed of issue and distribution

As the mass of scientific and technical knowledge obtained on the Project piled up, an increasing need was apparent for its digestion into survey or summary form In partial answer to this need, an editorial group was set up in the spring of 1943 to organize a Project Handbook Although never fully completed because of the engrossment of authors in immediately urgent tasks, and because of the transfer of many of them to other sites, enough of the Project Handbook was finished to be of real value

By the summer of 1944, the Metallurgical Project had largely concluded its major task, that of providing the scientific and pilot-plant know-how for the design of the large-scale Hanford Plutonium Plant The time seemed ripe to plan a series of volumes in which the Project's fund of accumulated scientific and technical knowledge would be

recorded These would replace the often sketchy and sometimes mutually contradictory C reports and fill many gaps of unwritten knowledge In the early planning, Laurence L Quill as Chief of the Editorial Section of the Project Information Division during the summer of 1944, Eugene Rabinowitch, and H H Goldsmith made important contributions After several committee meetings, a plan for the preparation of a Metallurgical Project Record was approved by the Project Director in the fall of 1944 Later, in 1945, the name was changed to Plutonium Project Report or Record (PPR)

When the PPR was organized, rigid compartmentation was still in effect between the Metallurgical Project and the other Manhattan District projects Members of each project were in general not supposed to know even the major objectives or main outlines of the other projects The PPR had therefore to be planned as an independent entity Nevertheless, at its inception the idea was firmly held that later on the Record should become part of a larger series covering the work of all the atomic energy projects This idea was repeatedly advocated and led in late 1945 to the plan for the Manhattan Project Technical Series (MPTS), a name which was finally revised to the present designation of National Nuclear Energy Series (NNES)

The general plan of organization of the PPR was that of a series of some twenty Survey volumes, called "A volumes," each documented by a like-numbered Collected Papers volume (or volumes), these were called "B volumes " In general, following somewhat a pattern set by the Project Handbook, a Survey volume was planned for each scientific or technical subject to which the Metallurgical Project had made sufficiently major contributions Each Survey volume was intended to be a fairly complete review or monograph (or else a collection of review chapters) on the subject field It was planned to cover work done both within and outside the Metallurgical Project, though with primary emphasis on the former, outside work being included only for the sake of accuracy and completeness

In contrast to the Survey volumes, each Collected Papers volume was designed to consist of individual papers, mostly from individual laboratories and more or less similar to articles in the scientific journals, they were to include only work done within the Project In planning the PPR, it was realized that some of the Survey volumes would overlap with possible volumes of other projects, but because of compartmentation restrictions, it was decided to proceed in general with the plan as outlined An exception was the field of uranium chemistry, where it was obvious that all the major projects were making important contributions In this field, a Handbook of Uranium Chemistry was planned early in 1944, to be edited and written at the Metallurgical Laboratory at Chicago, but as a cooperative effort of all the

projects, and based on a full interchange of information among them. When the Record was organized, this volume was tentatively included as one of the PPR Survey volumes, to be accompanied by a corresponding Collected Papers volume covering Metallurgical Project work only Later, when the MPTS (now NNES) was organized, these volumes, with the addition of Collected Papers from the other projects, were transferred to the over-all Division (Division VIII) of the technical series In the field of analytical chemistry, a Survey volume and a Collected Papers volume were planned for the PPR and were well on their way toward completion When the MPTS was organized, the content of these volumes was pooled with the work of other projects of the Manhattan District to form Survey and Collected Papers volumes of Division VIII of the MPTS In certain other fields, pooling of material from the different projects was also considered, but was felt to involve too large a task of reorganization

Because of the wide variety of subject matter, the organization of the PPR into Survey volumes, each accompanied by one or more Collected Papers volumes, is not always consistently followed There are a few Collected Papers volumes without corresponding Survey volumes, and the converse is also true Furthermore, the form of organization varies considerably from one volume to another because of varying subject matter and the preferences of the different volume editors and committees

When the PPR plans were approved toward the end of 1944, the completion deadline for the manuscripts was set for June 30, 1945, the date of dissolution of the Metallurgical Project Most of the PPR volumes were organized into three groups (1) chemistry and metallurgy, (2) physics and related engineering, (3) biology and medicine The first task was to obtain volume editors and editorial committees for the various volumes, to plan the contents, and to find authors John C Warner, as chemistry editor of the PPR and Chief of the Editorial Section of the Project Information Division from December 1944 to June 30, 1945, made decisive contributions to the chemistry and metallurgy volumes and to the general planning of the PPR

The organization of the volumes on physics and on biology and medicine went more slowly, partly because the subject matter was then less ripe for writing than was that on chemistry and metallurgy, partly because of the demands for continuing research and, in the field of instrumentation, for production of instruments to be used at Los Alamos, Hanford, and other sites Eugene P Wigner, Frederick Seitz, and H H Goldsmith took an active part in the early organization of the physics volumes Plans for the volumes on biology and medicine were very effectively organized by Raymond E Zirkle as PPR editor for these fields, with the backing of Robert S Stone as Associate

Project Director for Health Hoylande D Young entered the PPR program as Technical Editor in charge of final editing and processing of manuscripts, and after June 30, 1946, became General Editor

After the organization of the PPR, steady progress was made in the work of writing and editing, but at a slower pace than was originally hoped The dissolution of the Project on June 30, 1945, with the readjustments and administrative problems involved in a 50 per cent cut of total personnel, the end of the war after the bomb was dropped in August and the subsequent deep preoccupation and extensive activities of Project personnel in connection with the social and political implications of atomic energy and atomic warfare, new research and planning directed toward the postwar continuation of the atomic energy program, all these slowed the progress of the PPR writing program During this difficult period, invaluable encouragement and support of the PPR program came from, among others, Norman Hilberry, Associate Director of the Metallurgical Project up to the time of its dissolution, and Farrington Daniels, Director of the Metallurgical Laboratory in 1945-1946

Meantime, other projects in the Manhattan District group began the preparation of final accounts of their work In particular, the Los Alamos Technical Series was begun in 1945 Finally, the MPTS (now the NNES) was organized under the Manhattan District Editorial Advisory Board late in 1945 Under the chairmanship of Alberto F Thompson, as Chief of the Publications Section of the Research Division of the District, this group began the task of coordinating existing writing activities and filling the gaps in these, with the objective of producing a reasonably well-rounded series of volumes covering the work of the entire District During early 1946, rules for declassification were set up, and the editors of the MPTS volumes faced the difficult task of dividing the subject matter of their volumes into declassifiable parts, publishable immediately, and classified parts, for which publication must be deferred In June 1947 the completion of the editorial work of the PPR, as part of the NNES, was taken over by the Technical Information Division of the Atomic Energy Commission, at Oak Ridge, Tenn

In addition to those named above, many other project members worked together in planning the PPR After the general plans were made, the actual work of preparing the various volumes was in the hands of the volume editors, volume editorial committees, and authors, as described in the prefaces of the individual volumes

Robert S Mulliken
Editor-in-Chief,
Plutonium Project Record

PREFACE TO THE HEALTH VOLUMES IN DIVISION IV OF THE NATIONAL NUCLEAR ENERGY SERIES (MPTS)

The health volumes of Division IV contain reports of work done during World War II, under the Manhattan District, as part of the activities of the Metallurgical Project (known as the Plutonium Project after the bombing of Nagasaki) The material is distributed among the various volumes as follows

Vol 20	"Industrial Medicine" (Survey and Collected Papers)
Vol 21A	"Health Physics" (Survey)
Vol 21B	"Health Physics" (Collected Papers)
Vols 22B–22I	"Radiobiology" (Collected Papers)
Vols 22B–22C	"Effects of X and Gamma Rays"
Vol 22D	"Effects of Fast and Slow Neutrons"
Vol 22E	"Effects of External Beta Radiation"
Vols 22F–22H	"Metabolism and Effects of Internal Emitters"
Vol 22I	"Histopathology of Irradiation from External and Internal Sources"
Vol 23	"Toxicology of Uranium" (Survey and Collected Papers)

It will be noted that the foregoing outline includes no survey of radiobiology This was planned as Vol 22A but was abandoned because of shortage of authors

The work reported in the volumes just listed was mostly done at the Metallurgical Laboratory, University of Chicago, the Crocker Laboratory, University of California, Berkeley, Clinton Laboratories, Oak Ridge, Tenn , the National Cancer Institute, Bethesda, Md , and the Hanford Engineer Works, Richland, Wash It was all under the general supervision of Robert S Stone, M D , Associate Director for Health of the Metallurgical Project Dr Stone's introduction to this entire set of health volumes appears in Vol 20

The medical work was directly supervised by Simeon T. Cantril, M D (Chicago, Clinton, Hanford), Leon O Jacobson, M D (Chicago), John E Wirth, M D (Clinton), and James J Nickson, M D (Chicago) Health Physics was developed under the supervision of Herbert M Parker (Chicago, Clinton, Hanford), Ernest O Wollan (Chicago), Karl Z Morgan (Clinton), and John E Rose (Chicago) Research in radiobiology was directed by Kenneth S Cole (Chicago), Joseph G Hamilton,

lymphatics of the perirenal fat. The lymphatics of the parenchyma unite into larger trunks which emerge at the hilum of the kidney. Both the renal and perirenal lymphatics drain into lymph nodes behind the renal pelvis. Vessels from the renal lymph nodes drain into the lumbar lymph glands along the aorta and vena cava. The lymphatics of the kidney communicate with those of the periureteral sheath.

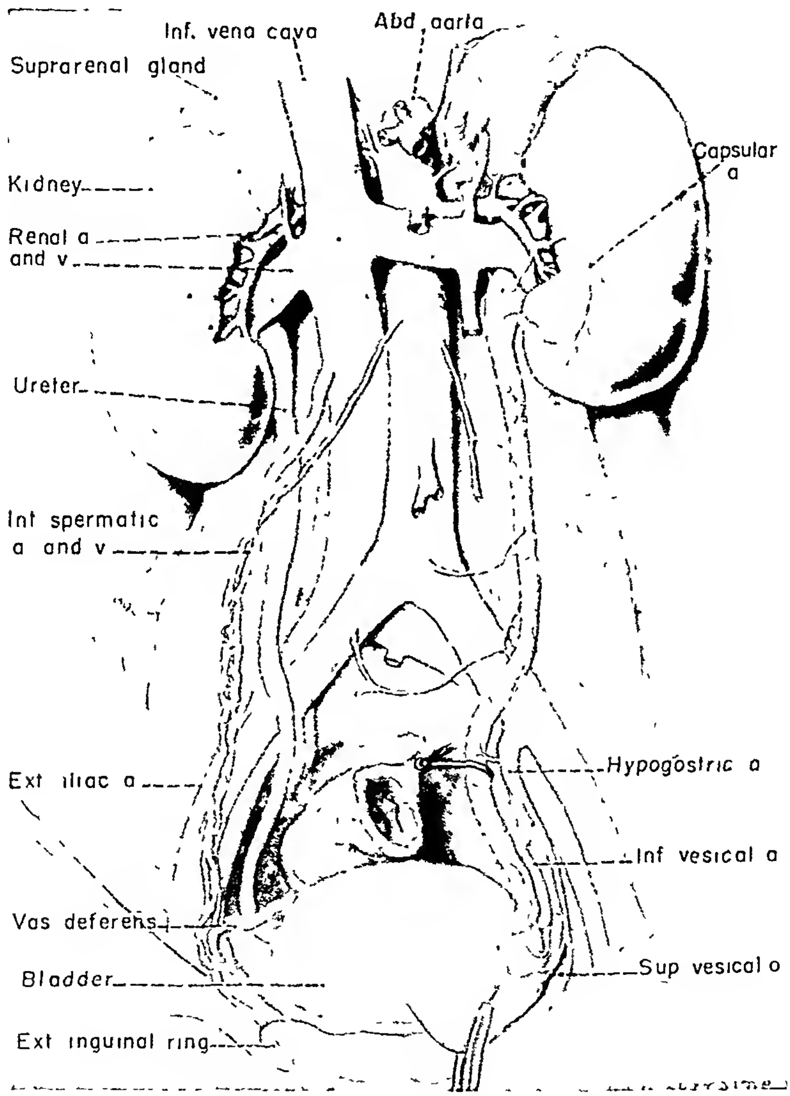

Fig 3—Blood supply of kidneys, ureters, adrenal glands, and bladder Relation of spermatic vessels to ureter (Campbell Urology, Vol 1, W B Saunders Co, Philadelphia, 1954)

Coverings.—The upper pole of the kidney is thicker and more rounded than the lower pole and is capped by the adrenal gland (Fig 3) The kidney is covered by a thin fibrous coat, the true capsule, which extends into the hilum to become continuous with the fibrous sheaths of the renal pelvis and the blood vessels Underneath the capsule is a thin, incomplete layer of unstriped muscle

The perirenal fascia consists of a condensation of the retroperitoneal connective tissue and is a part of the fascia propria which re-enforces the peri-

toneum It is composed of an anterior and a posterior layer The posterior layer is a more definite structure and is spoken of as the fascia of Gerota and Zuckerkandl It blends loosely with the psoas major and quadratus lumborum muscles Mitchel mentions this connection as providing an indirect attachment of the renal fascia to the intervertebral discs and the anterior spinal ligaments

The anterior layer of the perirenal fascia is not so dense as the posterior layer It is in contact with and fairly adherent to the overlying peritoneum in some areas and blends with intervening connective tissue when adjacent organs are in contact with the kidneys

Along the lateral margins of the kidneys and above the upper poles the two layers are firmly united They separate above the upper pole of each kidney to enclose the corresponding adrenal gland and unite again to become continuous with the aponeurotic covering of the diaphragm The two layers invest the renal pelvis and vessels medially and blend with the connective tissue surrounding the great vessels The fascial layers are less densely fused inferiorly and in the inferomedial aspect blend with the periureteral fascia The perirenal fascia tends to limit the spread of perirenal hematoma suppuration, or the extravasation of urine (Fig 6)

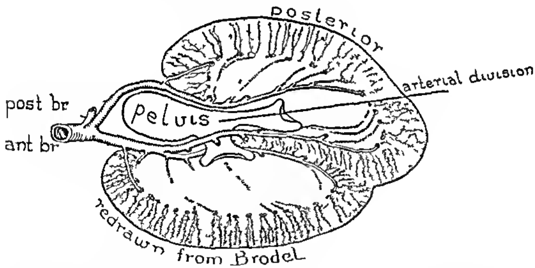

Fig 4 —Transverse section through human kidney showing distribution of arteries (Adapted from Kelly and Burnham Diseases of the Kidneys Ureters and Bladder D Appleton Century Company Inc)

Structure—The kidney consists of the cortical and medullary portions The cortical portion, four or five millimeters thick, dark reddish brown in color, and granular in appearance, lies between the capsule and the base of the pyramids, and projects between the pyramids These projections between the pyramids are known as the columns of Bertin The renal parenchyma of these columns is replaced by fibrous tissue in kidneys destroyed by pyonephrosis These fibrous septa may divide the kidney into two or more cavities which do not communicate freely with each other or with the kidney pelvis This must be taken into account when nephrostomy drainage is necessary The

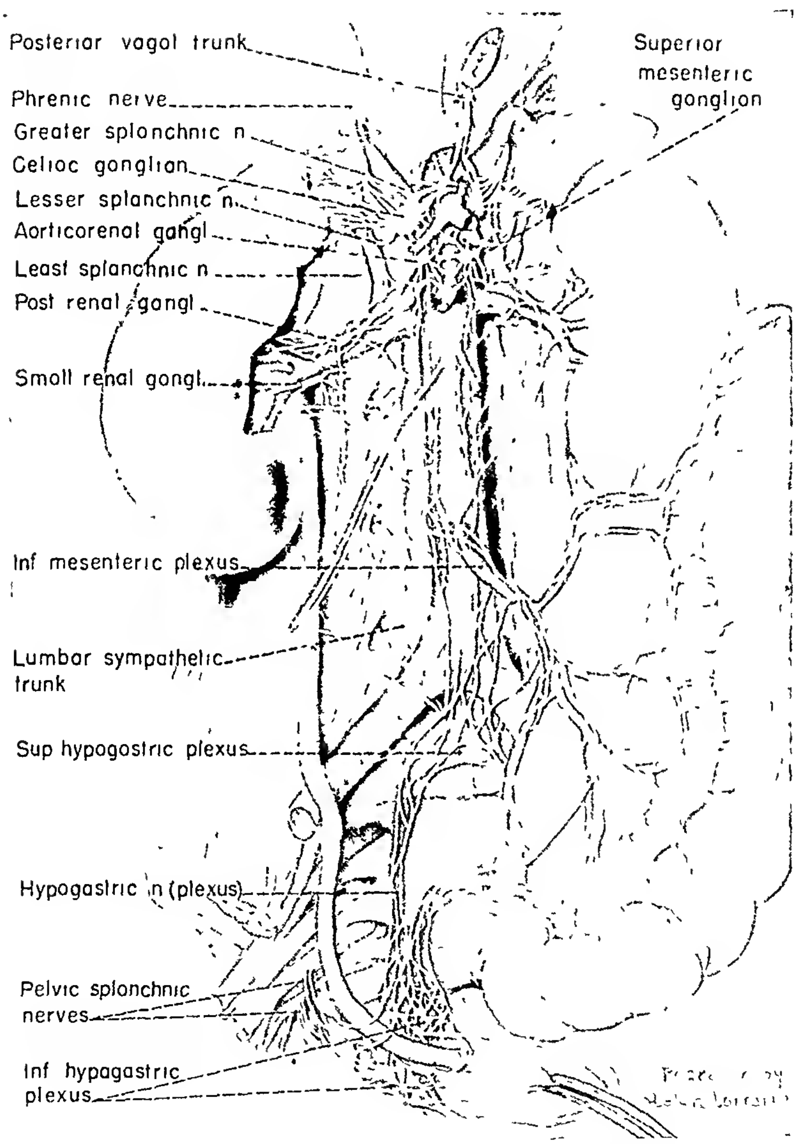

Fig 5—Nerve supply of kidneys, ureters, adrenal glands, and bladder (Campbell Urology, Vol 1, W B Saunders Co, Philadelphia, 1954)

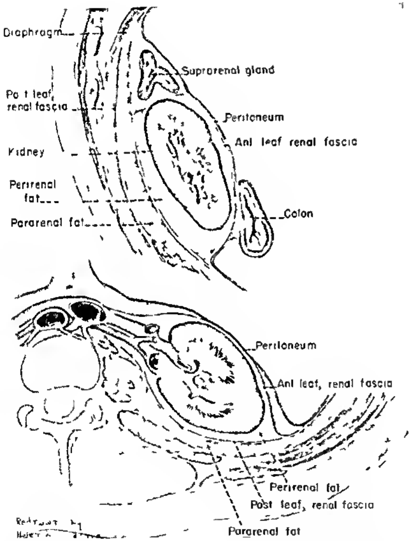

Fig 6—Transverse and longitudinal sections through kidney showing relationship of renal fascia (Campbell Urology Vol 1 W B Saunders Co Philadelphia 1954)

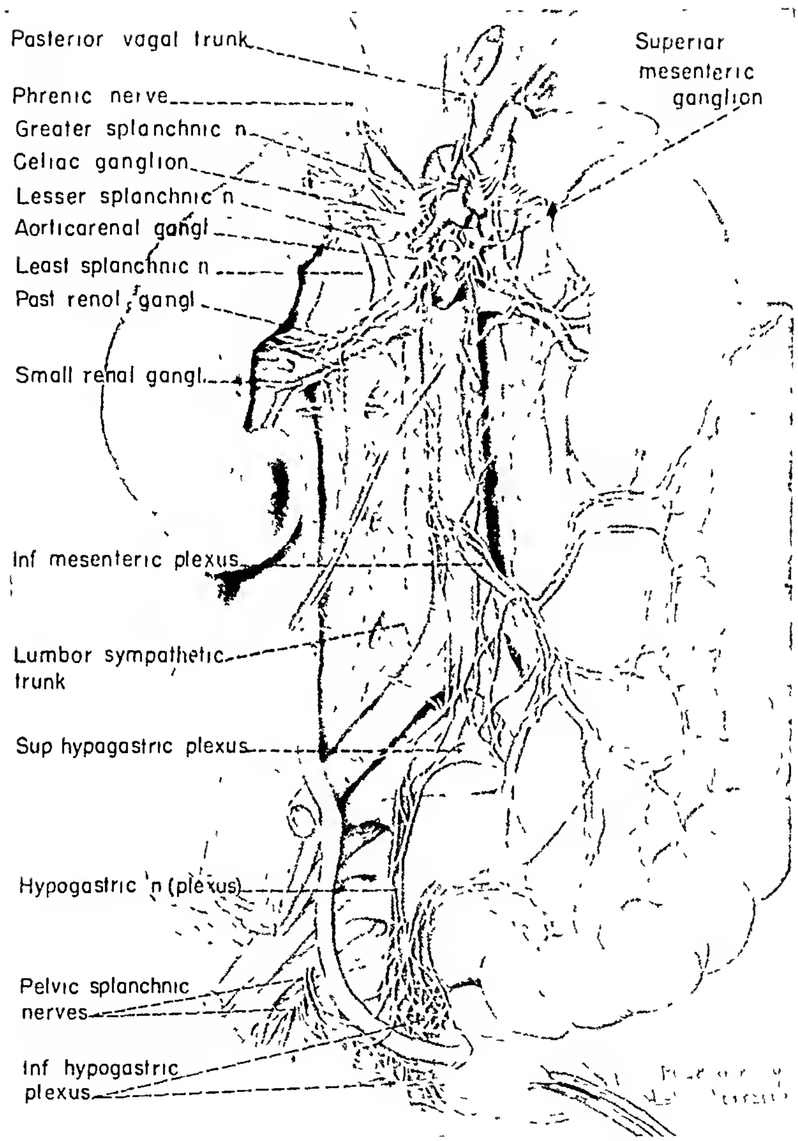

Fig 5—Nerve supply of kidneys, ureters, adrenal glands, and bladder (Campbell Urology, Vol 1, W. B Saunders Co, Philadelphia, 1954)

constriction is the lumbar spindle which has a diameter of 10 mm and below the iliac vessels is the pelvic spindle with a diameter from 4 to 6 mm (Fig 8) Calculi often become arrested in one of the narrow areas

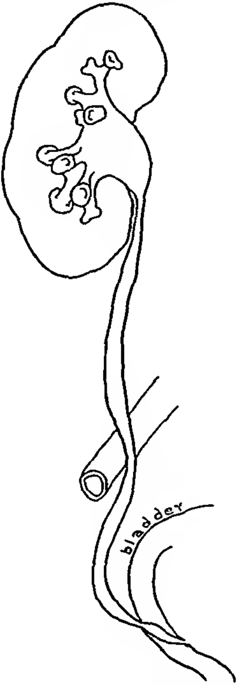

Fig 8—Diagram of kidney and ureter showing division of the pelvis into calyces and the normally constricted areas of the ureter

Structure—The ureter is composed of a fibrous, a muscular, and a mucous coat

The fibrous coat is a rough elastic membrane, continuous above with the fibrous covering of the kidney and blending below with the wall of the bladder

medullary portion of the kidney consists of from eight to fifteen reddish colored, striated, conical masses Their bases are continuous with the cortex and their apices project into the minor calyces of the kidney pelvis. In chronic pyelonephritis the normal markings of the kidney are much less distinct.

The Pelvis of the Kidney.—The pelvis is a funnel-shaped structure, situated partly in the hilum and partly outside the kidney. It is formed by from six to fourteen minor calyces which join to form two or three major calyces. The major calyces open into a single cavity, the pelvis, which measures from 1 8 × 1.8 to 2.1 × 2 1 cm. and has a capacity varying from 5 to 11 c c. (Fig. 7).

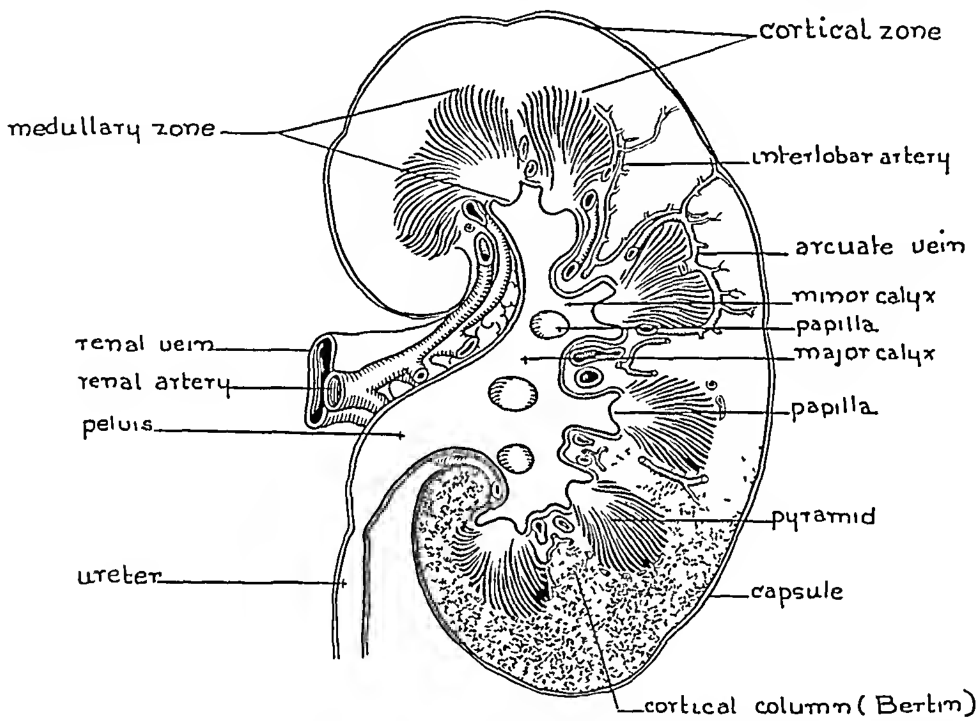

Fig 7—Longitudinal section through human kidney showing gross anatomy (Adapted from Kelly and Burnham Diseases of the Kidneys, Ureters, and Bladder, D Appleton-Century Company, Inc)

THE URETERS

The ureter is a fibromuscular tube which begins at the outlet of the renal pelvis 5 to 7 cm below the hilum of the kidney and extends to the ureteral orifice at one angle of the vesical trigone. The ureters vary in length from 28 to 34 cm. The left is about a centimeter longer than the right When the anomaly of two ureters to one kidney exists, the ureter draining the upper segment of the kidney enters the bladder below the ureter draining the lower portion. The caliber of the ureter varies in different areas and in different subjects. Three definitely constricted areas are recognized. The uppermost constriction is just below the kidney pelvis, the second where the ureter crosses the iliac vessels at the pelvic brim, and the third within the wall of the bladder The caliber of these areas averages about 3 mm. Between the first and second

constriction is the lumbar spindle which has a diameter of 10 mm and below the iliac vessels is the pelvic spindle with a diameter from 4 to 6 mm (Fig 8) Calculi often become arrested in one of the narrow areas

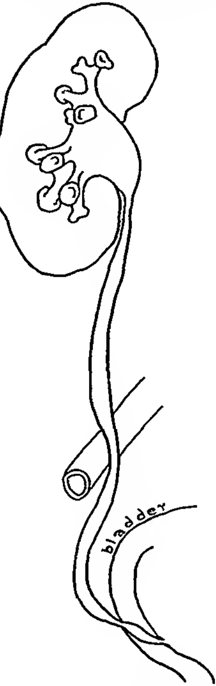

Fig 8—Diagram of kidney and ureter showing division of the pelvis into calyces and the normally constricted areas of the ureter

Structure—The ureter is composed of a fibrous, a muscular, and a mucous coat

The fibrous coat is a rough elastic membrane, continuous above with the fibrous covering of the kidney and blending below with the wall of the bladder

The muscular coat is continuous with the muscles of the kidney pelvis and consists of an external longitudinal and an internal circular layer The longitudinal muscle of the ureter continues across the trigone of the bladder, a portion running along the edge of the trigone and a portion decussating with fibers from the opposite ureter to form the interureteric ridge The ureter has no sphincter. Regurgitation is prevented by a valve of mucous membrane produced by the oblique course of the ureter through the bladder wall.

The mucous membrane is smooth and lies in longitudinal folds when the ureter is at rest. It is composed of transitional epithelium

Course and Relation to Other Structure.—From the renal pelvis to the iliac vessels the ureter lies upon the anterior surface of the psoas major muscle and just over the tips of the transverse processes of the spinal column. In front is the parietal peritoneum to which the ureter is loosely attached with the exception of the upper 4 or 5 cm This attachment is of surgical importance. When the peritoneum is dissected up for exposure of the ureter, the ureter should be looked for on the reflected peritoneum. The spermatic or ovarian vessels lie internal to the ureter for 6 or 8 cm. and then cross over to continue downward as an external relation (Fig. 3) On the right side, the right colic and ileocolic vessels also pass between the ureter and the peritoneum On the left side the ureter is crossed by the spermatic or ovarian vessels and by the left colic and sigmoidal vessels The genitocrural nerves cross behind the ureters. The right ureter passes behind the descending portion of the duodenum as it leaves the kidney and behind the terminal ileum and the vermiform appendix just above the iliac vessels When the appendix is retrocecal, it is in close relation with the ureter, and appendicitis may cause inflammation of the ureter with the elimination of blood and pus cells in the urine Randall has reported constriction of the midureter resulting from inflammation of the appendix At the pelvic brim the ureters cross the iliac vessels just at or lateral to their division into the external and internal iliacs The ureters then follow the contour of the pelvic wall in a downward and outward direction passing in front of all major vessels Opposite the ischial spine the course is medial and downward to the base of the bladder In the male each ureter passes under its respective vas deferens and enters the bladder in front of the upper end of the seminal vesicle (Fig. 3) Because of this relation disease of the seminal vesicles sometimes gives symptoms suggesting disease of the kidney and periureteral inflammation may cause constriction of the ureter In the female the ureter passes beneath the uterine artery, skirts the cervix, and enters the bladder in close relation to the anterior vaginal wall The relation to the uterine artery is frequently responsible for injury of the ureter during hysterectomy

Arteries of the Ureter.—The ureter obtains its blood supply from the renal, spermatic or ovarian, and superior and inferior vesicular arteries The arteries form a plexus of longitudinal branches in the loose fibrous outer coat of the ureter (Fig 3). The tributaries pierce the muscular coat at frequent intervals A similar but more delicate plexus of arteries is formed in the submucosa of the ureter. Capillaries run from this plexus to the muscular coat and to the mucous mem-

brane The abundant blood supply and the free anastomosis of the ureteral blood vessels make it possible to free the ureter almost completely without danger of necrosis The veins form a plexus in the submucosa and drain into the veins of the adventitia These veins drain into the spermatic or ovarian, the renal, the uterine and the vesical venous plexus

Lymphatics—Lymph channels accompany the arteries in the submucosa and in the periureteral sheath Those of the lower ureter drain downward Those of the upper ureter go toward the kidney and those of the midportion drain mesially into the pelvic and lumbar lymph nodes (Fig 11)

Innervation of the Ureter—The nerve supply of the ureter is derived from the autonomic nervous system and is independent of the renal pelvis and the bladder The nerves supplying the ureter have been carefully dissected by Wharton, who found that nerves pass to the ureter from the lowest renal ganglion at the head of the ovarian or of the spermatic plexus and from the aortic, hypogastric, and pelvic plexuses (Fig 5) These ganglia are supplied by the abdominal sympathetic trunks which are derived from the solar or celiac plexus The celiac plexus is formed by the greater and lesser splanchnics and the vagi, communicating branches from the upper lumbar prevertebral sympathetic ganglia, and from the sacral cord Wharton also demonstrated a connection between the ureteral innervation and the plexuses that supply the ovary, testis, and the parietal peritoneum Complete division of the nerves to the ureter will relieve ureteral pain without disturbing ureteral peristalsis or tone

The neurogenic origin of motor impulses is believed to come from ganglia in the adventitia and musculature of the ureter Peristalsis has been abolished in the ureter by complete denervation of the renal artery and vein This does not occur when the artery alone is denervated

THE BLADDER

The bladder is a musculomembranous saccular pelvic organ (Fig 9) When empty it lies in the anterior portion of the true pelvis When distended it projects well into the abdomen At birth the bladder is mainly an abdominal organ It is ovoid and lies just beneath the abdominal wall Its base is behind the symphysis pubis During infancy and childhood the bladder gradually descends into the true pelvis and becomes almost spherical The bladder is composed of four coats the fibrous, the muscular, the submucous, and the mucous, named from without inward In addition the peritoneum forms a covering for the greater portion of the bladder surface

The fibrous layer is composed of loosely arranged fibroelastic tissue containing considerable fat This layer is thicker over the lower portion of the bladder which is not covered by peritoneum It is attached to the muscular coat and at the base blends with the pelvic fascia

The muscular coat consists of three layers of unstriated muscle The external layer is longitudinal and posteriorly its fibers are intimately associated with the deep layer of the rectovesical fascia Posteriorly the external muscle fibers extend up from the prostate over the fundus and meet similar fibers from

the anterior surface. At the sides the longitudinal muscles are thin or absent. The middle layer is circular, thicker than the external layer, and the fibers are densely interlaced. The internal layer is longitudinal, quite thin and inconspicuous The internal sphincter of the bladder is composed of fibers from the external and middle muscular layers. The trigone is a separate muscle arising from the longitudinal muscles of the ureters which pass down, interlace with each other, and are inserted into the posterior urethra.

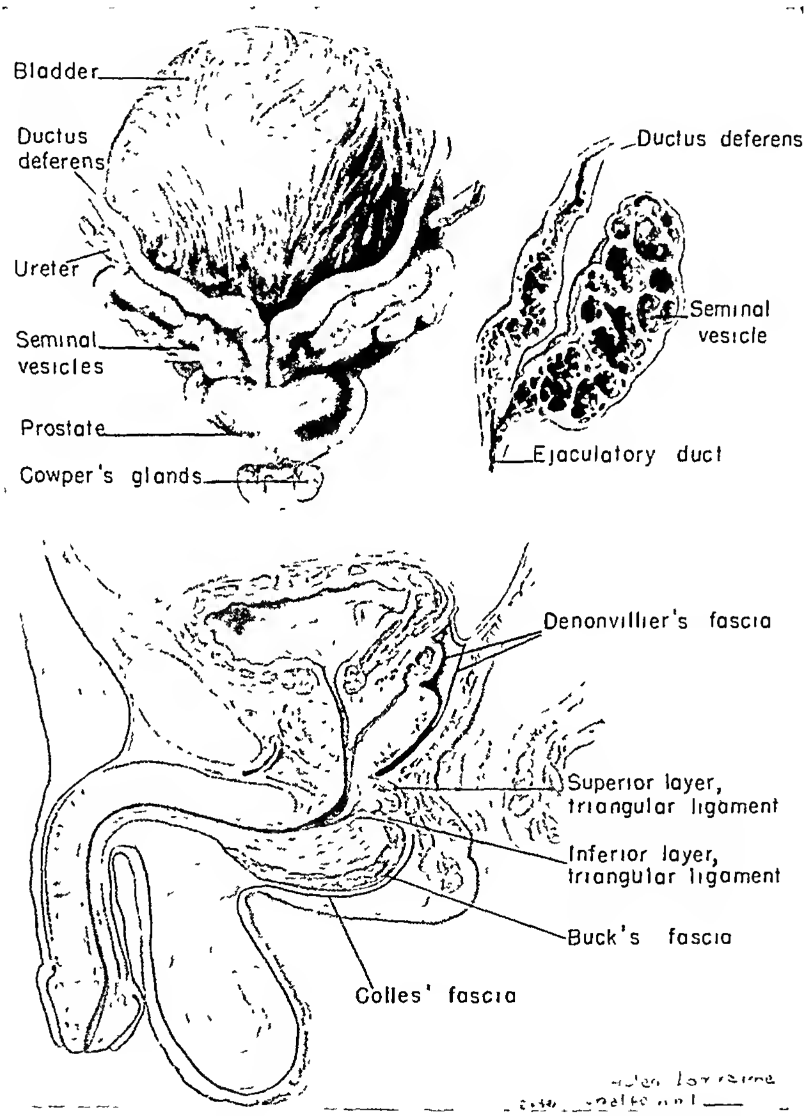

Fig 9—Relationship of bladder and genital structures (after Spalteholz) (Campbell Urology, Vol 1, W B Saunders Co, Philadelphia, 1954)

The submucous coat is made up of fibrous and elastic tissue It connects the mucous membrane with the muscular coat. The mucous membrane is composed of transitional epithelium It is a pale salmon color, and lies in folds when the bladder is empty, except over the trigone where it is always smooth. The mucous membrane contains a few glands situated usually on the trigone.

For descriptive purposes the bladder may be divided into a vault or superior portion, two lateral walls, a fundus or base, and a trigone. The trigone is the triangular space included between the two ureteral orifices and the bladder orifice (Fig 10)

The peritoneum is reflected from the anterior abdominal wall over the urachus onto the anterior wall of the bladder. When the bladder is empty, the peritoneum reaches to or behind the symphysis. When the bladder is distended, the line of peritoneal reflection lies from one to two inches above the

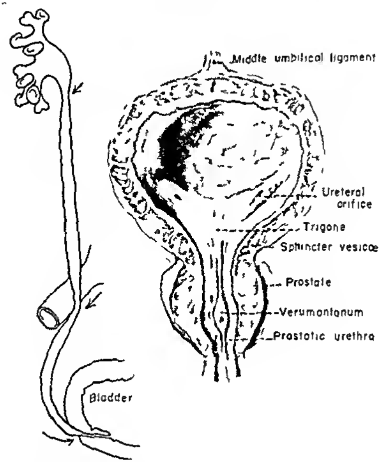

Fig 10—Bladder and prostate sectioned to show structure of bladder wall and points of interest in base of bladder and posterior urethra. Diagram showing normal areas of ureteral constriction. (Campbell Urology Vol 1 W B Saunders Co Philadelphia 1954)

symphysis. The peritoneum at this area is loosely attached to the bladder and may be easily stripped upward from the anterior wall, permitting extraperitoneal surgical approach to the bladder. The peritoneum covers the fundus of the bladder and extends downward on the posterior surface almost to the area at which the ureters reach the bladder (Fig 9). From this area the peritoneum is reflected to the rectum in the male and the uterus in the female. From the lateral walls of the bladder the peritoneum may be traced to the lateral pelvic walls. These areas of peritoneal reflection are spoken of as false ligaments of the bladder. The bladder is partly surrounded by loose areolar connective

tissue which permits a wide range of mobility. The space anterior to the bladder and bound in front by the posterior surface of the pubis and the posterior surface of the lower abdominal wall is called the prevesical space of Retzius. It is in this area that infection is apt to occur following suprapubic operations upon the bladder and in which there is extravasation of blood and urine following extraperitoneal rupture of the bladder

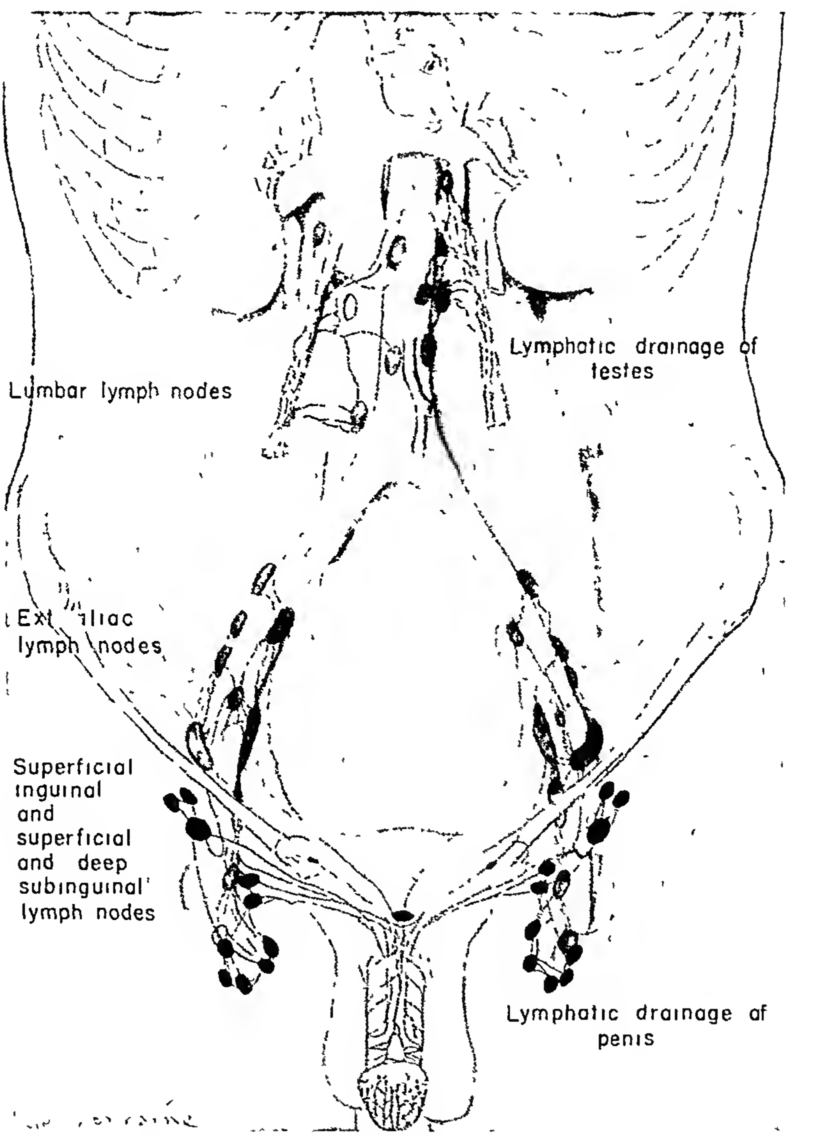

Fig 11 —The lymphatic system as related to the genitourinary tract

The base of the bladder is the only fixed portion Here it is continuous with the prostate and urethra in the male and is attached to the pubic bones and fascial coverings of the levator ani muscles by the true ligaments of the bladder (Fig 9). These ligaments are fascial bands arising from the pelvic fascia .The bladder may be torn when the pubic bones are fractured and there is wide separation of the fragments The rectovesical fascia (of Denonvillier) supports the base of the bladder and separates it from the rectum.

Anteriorly and above, the bladder is held in position by the median umbilical ligament which contains the urachus

Blood Supply—Terminal branches of the anterior division of the internal iliac artery are distributed to the bladder The most important of these are the superior and inferior vesical arteries (Fig 3) In some cases the superior vesical arteries give off middle vesical arteries Smaller vessels reach the bladder from the middle hemorrhoidal, obturator, internal pudic and inferior pudic arteries In the female small branches of the uterine and vaginal arteries are distributed to the bladder Arterial plexuses are formed in the fibrous and submucous layers of the bladder

The veins are arranged in a plexiform manner throughout the walls of the bladder They empty into the hypogastric veins

The Lymphatics drain into nodes arranged along the external iliac and hypogastric vessels (Fig 11)

Nerve Supply—The sympathetic nerves to the bladder are derived from the first four lumbar sympathetic ganglia These nerves are collected beneath the peritoneum over the fifth lumbar vertebra as the superior hypogastric plexus (Fig 5) Two hypogastric nerves emerge from this plexus, each of which ends in a corresponding hypogastric ganglion on the lateral aspect of the rectum These ganglia probably also receive sympathetic fibers from the third and fourth sacral ganglia of the paravertebral sympathetic chains The hypogastric ganglia are joined by the anterior primary division of the second and third sacral nerves which supply the parasympathetic fibers From the anterior border of the hypogastric ganglia emerge a dozen or more branches of distribution, the upper branches containing both sympathetic and parasympathetic nerves to the bladder The prostatic urethra and the external sphincter receive somatic fibers by way of the pudic nerves which spring from the primary division of the third and fourth sacral nerves In the opinion of Learmonth this nervous pathway contains direct connections between the nerves of the kidneys and those of the ureters and bladder, providing a pathway which probably coordinates the activities of these organs He further states that stimulation of the sympathetic pathway causes contraction of the ureteral orifices, of the trigone and of the internal sphincter, as well as of the muscles of the prostate and seminal vesicles, and emphasizes the fact that the sympathetic system controls the trigonal region and the internal sphincter Both the sympathetic and parasympathetic nerves convey impulses giving information as to the degree of the distention of the musculature of the bladder Both pathways likewise convey sensations of pain The parasympathetic nerves convey excitor impulses to the detrusor muscles Division of the sympathetic nerves does not materially interfere with micturition, therefore, the most important pathway for reflex fibers is the parasympathetic system

Relations of the Bladder—Anterior to the bladder are the pubic bones, the retropubic fat, the anterior vesical veins and the vesical portion of the pelvic fascia When the bladder is distended a portion of its anterior surface lies just beneath the anterior abdominal wall Laterally the bladder is in relation with the levator ani and obturator internus muscles, the vesicoprostatic

venous plexus, and the parietal layer of the pelvic fascia. In the male the posteroinferior portion or base of the bladder is separated from the rectum by the rectovesical fascia, the seminal vesicles, and the terminal portions of the vasa deferentia (Fig. 9). The terminal portions of the ureters pass internal to the vasa and lie between the terminal portions of the seminal vesicles and the bladder wall. In the female the bladder is separated posteriorly from the uterus by the uterovesical pouch of peritoneum. Below this pouch the bladder lies upon the anterior surface of the cervix and the anterior surface of the vaginal wall. The bladder is in relation to the anterior layer of the broad ligament lateral to the ureters. Posteriorly and superiorly the bladder is separated from the pelvic colon and the small intestines by the peritoneum. Intestinovesical fistulas occasionally result from inflammatory adhesions of the intestines to the peritoneal surface of the bladder.

THE MALE URETHRA AND ITS SUPPORTING STRUCTURES

Approximately the posterior half of the male urethra is surrounded and supported by the muscles and fascia of the perineum, and it is through these structures that this portion of the urethra is approached for surgical treatment. The perineal structures are also of interest because of the relation they bear to the prostate, seminal vesicles, bladder, and rectum.

The perineum occupies the entire pelvic outlet and is composed of the musculomembranous pelvic diaphragm and the soft tissues lying inferior to it (Fig 12) The pelvic diaphragm forms the floor of the pelvic cavity and is composed of the levator ani and coccygeus muscles, their aponeurotic vestments, and a dense transverse fibrous septum known as the triangular ligament. Most of the perineal structures anterior to the anus form a dense union between the anorectal junction and the apex of the prostate known as the central point of the perineum. At this point the bulbocavernosus, the sphincter ani, and the superficial transverse perineal muscles meet, and their aponeurotic fibers blend with the posterior fibers of the triangular ligament (Fig. 12) It is also a point of insertion for levator fibers that support the prostate. This central body is an important landmark in perineal surgery and on the surface corresponds to a point midway between the anus and the penoscrotal junction.

The levator ani muscles arise from the inner aspect of the pelvic wall from a point slightly lateral to the lower border of the symphysis anteriorly to the ischial spine posteriorly These broad muscle bundles descend obliquely downward and inward, forming a funnel-like structure, with the walls converging downward to the lower rectum and anal canal.

The anterior fibers from the pubic bone pass beneath the prostate, some going to its capsule, some to the central point of the perineum and others to the front and sides of the rectum The posterior fibers of the levator ani pass the rectum, to be inserted in the side of the coccyx and to a fibrous band running from the coccyx to the anus. The coccygeus arises from the spine of the ischium and is inserted in the border of the coccyx in the same plane and continuous with the levator ani.

The anterior fibers of the levator ani muscles arise lateral to the symphysis on either side, leaving a hiatus or defect in the muscular diaphragm This space is partly occupied by the prostate, and the aponeurosis which borders the medial margins of the muscles is adherent to the lateral margins of the prostate, and is known as the lateral puboprostatic ligaments At the apex of the prostate the superior layer of the triangular ligament helps to maintain the prostate and bladder within the pelvic cavity

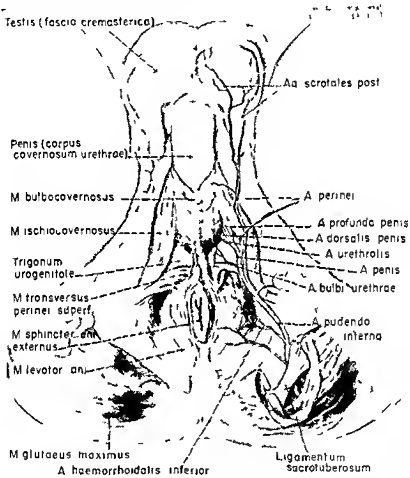

Fig 12—Anatomy of the perineum (after Spalteholz) (Campbell Urology Vol 1 W B Saunders Co Philadelphia 1954)

The triangular ligament, or urogenital diaphragm, consists of two layers of fascia stretched across the pubic arch from one pubic ramus to the other (Figs 9 and 13) It assists in closing the anterior portion of the pelvic outlet, thereby separating the pelvis from the perineum anteriorly The superior layer of the triangular ligament is not so well differentiated as the inferior or superficial layer It is continuous through the interlevator cleft with the pelvic fascia The inferior or superficial layer is deficient immediately behind the subpubic angle The thickened free margin is known as the transverse perineal ligament Posteriorly, the two layers of fascia blend with each other, with Colles' fascia, and with the central point of the perineum This fusion of the fascial layers of the perineum posteriorly forms two partly closed areas, the superficial and the deep perineal compartments of the urogenital perineum

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limits the course of infection and extravasation of urine arising from the bulbous urethra (Fig 13) Infection and extravasation in this area distend the anterior superficial compartment of the perineum and extend to the scrotum, penis, and anterior abdominal wall Infection is prevented from extending to the thighs by the attachment of Scarpa's fascia to the fascia lata and from entering the deep compartment of the perineum by the inferior layer of the triangular ligament

The superficial compartment of the urogenital perineum confined between the inferior layer of the triangular ligament and Colles' fascia is divided into two spaces by a septum extending from Colles' fascia to the raphe of the bulbocavernosus muscle As stated above, its only outlet is anterior This space contains the bulbous portions of the urethra surrounded by its cavernous body, the roots of the corpora cavernosa of the penis their overlying bulbocavernosus and ischiocavernosus muscles, and branches of the pudendal vessels and nerves that pierce the inferior layer of the triangular ligament to reach the space The corpora cavernosa of the penis arise from the midportion of the ischiopubic rami and extend upward and forward, closely attached to the periosteum of the pubis and to the inferior surface of the triangular ligament Each cavernous body is covered by the ischiocavernosus muscle The bulbous urethra begins at the inferior layer of the triangular ligament, is soon invested with the corpus cavernosum of the urethra and the bulbocavernosus muscle, and is directed forward to form the central body of the penis Immediately below the triangular ligament the urethra for a short distance is free of muscular covering and presents a slight dilatation on its inferior surface known as the cul de sac of the bulb Infection of the urethra in this area posterior to a stricture may result in periurethral abscess or perineal phlegmon, sometimes infiltrating the superficial perineal compartment and extending to the anterior abdominal wall Straddle injuries, forcing the urethra against the pubis or subpubic ligament, may cause rupture of the urethra in this area with extravasation of urine and blood into the superficial perineal pouch

The superficial transverse perineal muscles arise from the ischial tuberosities and pass medially and a little forward to join the central point of the perineum midway between the bulb of the urethra and the anus They occupy the most posterior portion of the superficial perineal compartment and are an important landmark in perineal surgery The spaces on each side of the bulbous urethra are traversed by small branches of the pudendal vessels and nerves

The deep compartment of the urogenital perineum lies between the layers of the triangular ligament This space is principally occupied by the membranous urethra and its sphincter muscle The deep transverse perineal muscles intimately connected with the superior layer of the triangular ligament traverse the space behind the urethra They arise from the ischial rami and interlace in a tendinous raphe behind the striated sphincter of the urethra

The membranous urethra extends from the apex of the prostate to the inferior layer of the triangular ligament It is about one centimeter long and lies two and one half centimeters behind the subpubic ligament It is firmly

The urogenital perineum extends from the symphysis pubis to the central point of the perineum just anterior to the anus and is limited laterally by the pubic arch. It contains the membranous and bulbous portions of the urethra and the muscular and membranous structures which give them support and protection The portion of the perineum posterior to the central point is called the posterior or anal perineum. These areas are related through their common levator substratum and are supplied in common by the internal pudendal vessels and nerves. They participate jointly in the formation of the central point of the perineum

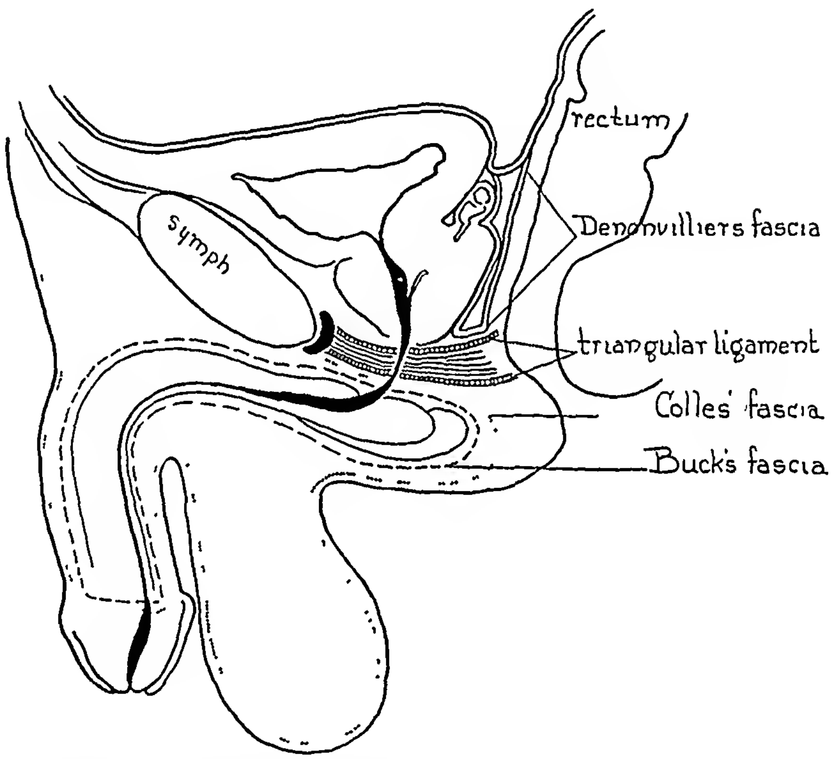

Fig. 13—Diagram of fascia of the urogenital region which confines and directs the course of suppurative processes in this area (Redrawn from Eisendrath and Rolnick Urology, J B Lippincott Company)

Beginning at the surface of the perineum the superficial fascia is the first structure of surgical importance. This fascia consists of two layers. The outer layer is continuous with the fatty covering of the body. Over the perineum there is little fatty tissue but chiefly smooth muscle fibers which are continuous anteriorly with the dartos layer of the scrotum. The deeper layer, Colles' fascia, is a dense membranous fascia covering only the urogenital region and attached laterally on each side to the periosteum of the pubic arch (Figs 9 and 13) As previously mentioned, it is fused posteriorly with the base of the triangular ligament. Anteriorly, it is continuous over the scrotum and penis and along the spermatic cord to the anterior abdominal wall where it is continuous with Scarpa's fascia, the deeper layer of the superficial fascia. This fascia forms a roof for the superficial perineal compartment of the urogenital perineum and

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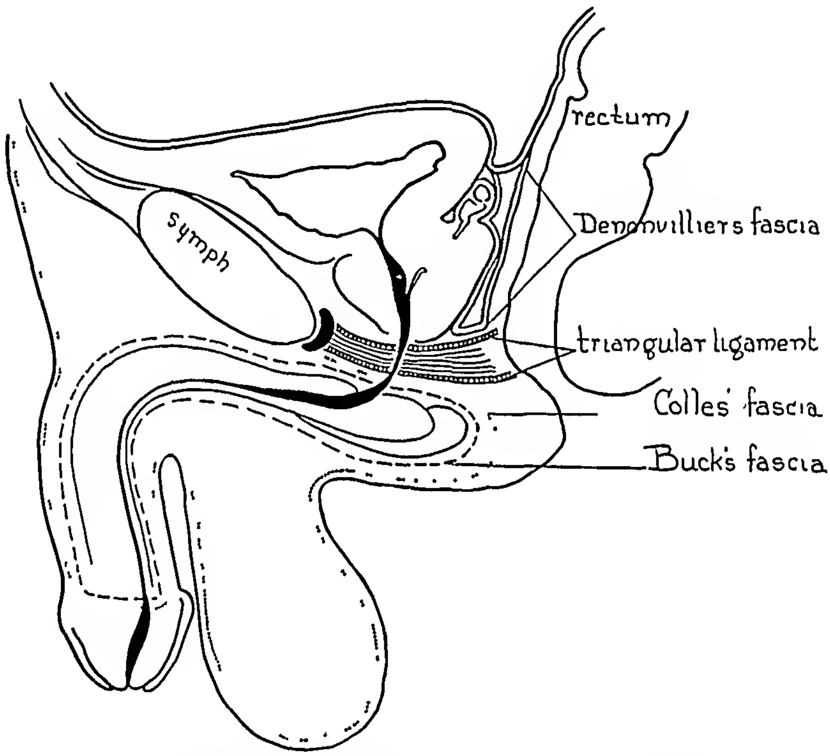

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The urogenital perineum extends from the symphysis pubis to the central point of the perineum just anterior to the anus and is limited laterally by the pubic arch. It contains the membranous and bulbous portions of the urethra and the muscular and membranous structures which give them support and protection. The portion of the perineum posterior to the central point is called the posterior or anal perineum. These areas are related through their common levator substratum and are supplied in common by the internal pudendal vessels and nerves They participate jointly in the formation of the central point of the perineum.

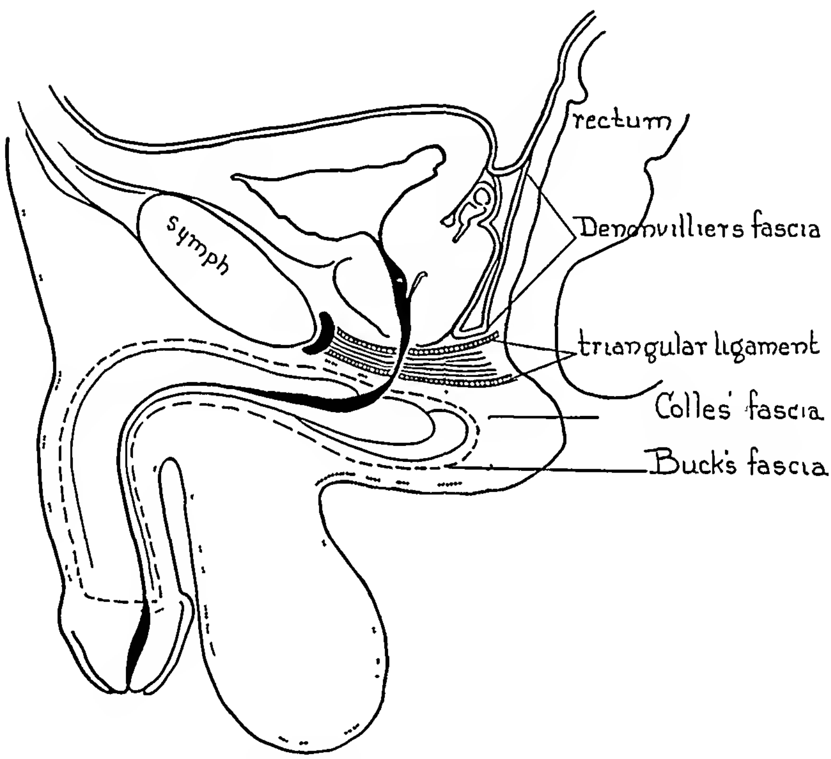

Fig 13 —Diagram of fascia of the urogenital region which confines and directs the course of suppurative processes in this area (Redrawn from Eisendrath and Rolnick Urology, J B Lippincott Company)

Beginning at the surface of the perineum the superficial fascia is the first structure of surgical importance. This fascia consists of two layers. The outer layer is continuous with the fatty covering of the body. Over the perineum there is little fatty tissue but chiefly smooth muscle fibers which are continuous anteriorly with the dartos layer of the scrotum The deeper layer, Colles' fascia, is a dense membranous fascia covering only the urogenital region and attached laterally on each side to the periosteum of the pubic arch (Figs 9 and 13). As previously mentioned, it is fused posteriorly with the base of the triangular ligament. Anteriorly, it is continuous over the scrotum and penis and along the spermatic cord to the anterior abdominal wall where it is continuous with Scarpa's fascia, the deeper layer of the superficial fascia. This fascia forms a roof for the superficial perineal compartment of the urogenital perineum and

limits the course of infection and extravasation of urine arising from the bulbous urethra (Fig 13) Infection and extravasation in this area distend the anterior superficial compartment of the perineum and extend to the scrotum, penis, and anterior abdominal wall Infection is prevented from extending to the thighs by the attachment of Scarpa's fascia to the fascia lata and from entering the deep compartment of the perineum by the inferior layer of the triangular ligament

The superficial compartment of the urogenital perineum confined between the inferior layer of the triangular ligament and Colles' fascia is divided into two spaces by a septum extending from Colles' fascia to the raphe of the bulbo cavernosus muscle As stated above, its only outlet is anterior This space contains the bulbous portions of the urethra surrounded by its cavernous body, the roots of the corpora cavernosa of the penis, their overlying bulbocavernosus and ischiocavernosus muscles, and branches of the pudendal vessels and nerves that pierce the inferior layer of the triangular ligament to reach the space The corpora cavernosa of the penis arise from the midportion of the ischiopubic rami and extend upward and forward closely attached to the periosteum of the pubis and to the inferior surface of the triangular ligament Each cavernous body is covered by the ischiocavernosus muscle The bulbous urethra begins at the inferior layer of the triangular ligament, is soon invested with the corpus cavernosum of the urethra and the bulbocavernosus muscle, and is directed forward to form the central body of the penis Immediately below the triangular ligament, the urethra for a short distance is free of muscular covering and presents a slight dilatation on its inferior surface known as the cul de sac of the bulb Infection of the urethra in this area posterior to a stricture may result in periurethral abscess or perineal phlegmon, sometimes infiltrating the superficial perineal compartment and extending to the anterior abdominal wall Straddle injuries, forcing the urethra against the pubis or subpubic ligament may cause rupture of the urethra in this area with extravasation of urine and blood into the superficial perineal pouch

The superficial transverse perineal muscles arise from the ischial tuberosities and pass medially and a little forward to join the central point of the perineum midway between the bulb of the urethra and the anus They occupy the most posterior portion of the superficial perineal compartment and are an important landmark in perineal surgery The spaces on each side of the bulbous urethra are traversed by small branches of the pudendal vessels and nerves

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fixed to the triangular ligament and, consequently, is often ruptured when this ligament is torn as a result of fracture of the pelvis The membranous urethra may also be injured when forced against the subpubic ligament by a severe blow on the perineum.

The deep compartment of the urogenital perineum also contains Cowper's glands whose ducts pierce the inferior layer of the triangular ligament and enter the bulbous urethra. The internal pudendal vessels and the dorsal nerve of the penis traverse this area. This compartment lies directly beneath the anterior extension of the ischiorectal fossa which runs toward the pubis between the deep layer of the triangular ligament, the anterior portion of the levator ani, and the medial surface of the obturator internus muscle. Extravasation and suppuration into the deep compartment usually extend upward into the prevesical area, but may find their way into the ischiorectal fossa and point in the anal perineum

The pendulous portion of the urethra occupies a very superficial position in the ventral groove between the corpora cavernosa of the penis (Fig. 12) It is covered by a thin layer of cavernous tissue, two layers of fascia, and the skin Incision into the pendulous urethra is avoided whenever possible because of the tendency to persistent fistula. Strictures occurring in this area are treated by dilatation or internal urethrotomy. Because of its protected position and mobility, it is not often injured.

THE FEMALE URETHRA

The female urethra is about one and one-half inches in length, and runs obliquely downward and forward from the neck of the bladder to the external urinary meatus Covered by the anterior vaginal wall, it perforates the two layers of the triangular ligament, and curves slightly forward. It is wider and more distensible than the male urethra. Embryologically it corresponds to the posterior portion of the male urethra.

The urethral wall is composed of mucous, submucous, and muscular coats The mucous coat consists of stratified squamous epithelium and is thrown into longitudinal folds. It contains many small lacunae and mucous glands The submucous coat is made up of loose connective tissue and blood vessels. The muscular coat is composed of an internal longitudinal layer and an external circular layer of nonstriated muscle fibers Additional fibers continuous with the internal sphincter of the bladder surround the proximal end The compressor urethrae muscle, a layer of striated muscle fibers, surrounds the urethra between the layers of the triangular ligament. The urethral meatus is situated in the vestibule of the vulva between the clitoris and the vagina The lips of the meatus are two prominent folds of mucous membrane, on the surface, or just inside, of which the orifice of Skene's glands are located.

The blood supply is derived from the internal pudic, the inferior vesical, and the uterine arteries. The veins drain into the perivesical or pudendal plexuses

The lymphatics drain into the inguinal nodes and into the pelvic and hypogastric nodes

The nerves are supplied by the pudic the genitofemoral and the vesical plexus of the sympathetic

THE PENIS

The penis is composed of three erectile bodies, two corpora cavernosa which are of equal size and lie on the same plane and the corpus spongiosum which is a smaller body lying beneath the two corpora cavernosa (Fig 14) Each of these bodies is of a vascular, spongelike structure, and covered by a dense fibro elastic sheath These erectile bodies have their origin in the superficial compartment of the urogenital perineum and after passing forward and upward become firmly united at the apex of this compartment just beneath the pubic angle The roots of the corpora cavernosa arise from the midportion of the *ischiopubic rami and are adherent to the descending rami of the* pubes and to the inferior surface of the triangular ligament The fixed portions of the corpora cavernosa are covered by the ischiocavernosus muscles which arise from the ischial tuberosities and are inserted into the sides and undersurfaces of the fascial coverings of these cavernous bodies

The corpus spongiosum surrounds the urethra from the triangular ligament to the meatus It begins as an expanded portion with the bulb attached to the undersurface of the triangular ligament and lying between the converging corpora cavernosa Beneath the pubic angle it becomes intimately attached in the ventral groove between the corpora cavernosa as they join to form the body of the penis The corpus spongiosum is covered through its perineal course by the bulbocavernosus muscle which arises from the central point of the perineum, passes upward and forward, and surrounds the bulb

The body of the penis begins beneath the angle of the pubis to which it is attached by firm bands of connective tissue The two larger bodies, the corpora cavernosa, lie side by side, with the corpus spongiosum in the ventral groove beneath them The cavernous bodies terminate in rounded extremities which are capped by the greatly expanded end of the corpus spongiosum, the glans penis (Figs 14 and 15)

The glans penis is a conelike body with an expanded posterior border, the corona glandis, and a grooved undersurface which receives the attachment of the frenum At the summit there is an anteroposterior slit, the meatus of the urethra The glans is covered by a delicate, sensitive, semimucous membrane which contains numerous sebaceous glands

Each of the erectile bodies is surrounded by a dense fibroelastic sheath, the tunica albuginea, the trabeculae of which surround the blood spaces Injury of this fibrous sheath causes profuse bleeding from the underlying cavernous tissue *If the wound is not carefully repaired, permanent deformity* of the penis may result As a result of disease or prolonged engorgement, blood may become coagulated in the cavernous spaces causing prolonged and painful priapism The condition can usually be relieved by aspirating the blood spaces through a large needle The tunica albuginea is somewhat thicker between the

corpora cavernosa, *forming a fibrous partition or septum*. By careful dissection the corpora may be separated one from the other without injury to the cavernous tissue.

All three cavernous bodies are bound together by an elastic sheath known as Buck's fascia. It completely covers the rounded extremities of the corpora cavernosa and is firmly attached to the base of the glans. It is fused with the fibers of the suspensory ligament and is continued backward in the perineum to the posterior margin of the triangular ligament (Fig 9).

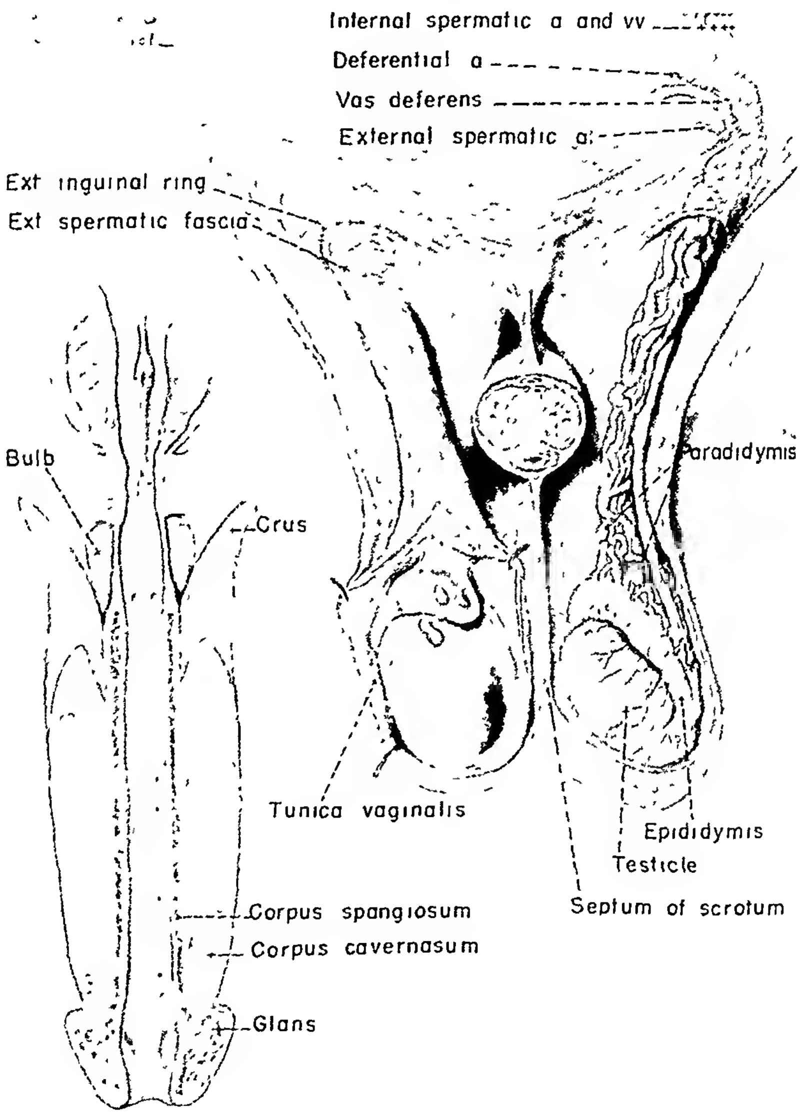

Fig 11—Penis and testes (after Spalteholz) (Campbell, Urology, Vol 1, W B Saunders Co, Philadelphia, 1954)

The suspensory ligament is a dense band of fibers from the front of the symphysis pubis which extends to and blends with the fibrous sheath of the penis at the base of its mobile portion. Colles' fascia invests the penis just beneath the skin and is continuous over the scrotum and perineum.

The penis is covered by thin, loosely attached skin devoid of fat and hair except at the base of the organ There is a reduplication of the terminal skin of the penis, the prepuce, to form a protective covering for the glans The internal surface of the prepuce is delicate in structure and resembles mucous membrane although covered with epithelium similar to that of the adjoining skin The surfaces of the prepuce join at a narrowed area called the orifice of the prepuce The tissue between the layers is loose and, like the remaining subcutaneous tissue of the penis, is devoid of fat The prepuce is attached to the base of the glans and a small median fold known as the frenum is attached just behind the lower angle of the meatus The frenum contains a small artery and bleeds rather profusely when injured Normally the prepuce can be retracted behind the glans

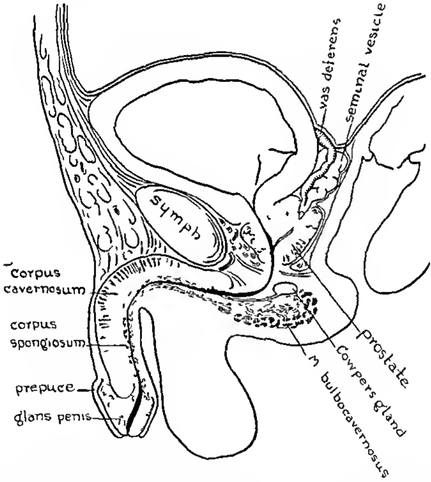

Fig 15—Longitudinal section through the male pelvis illustrating the anatomy of the penis urethra and genital gland except the testicles The position of the moderately distended bladder is also shown

Congenital or inflammatory narrowing of the preputial orifice produces a condition known as phimosis which may require circumcision or an incision to enlarge the orifice Persistent phimosis interferes with adequate personal hygiene and may result in severe inflammation and ulceration of the surface of the glans penis and the undersurface of the prepuce Circumcision in infancy

is an effective means of preventing carcinoma of the penis in later life. The blood supply of the penis is very abundant with liberal anastomoses between the terminal branches of the different arteries. This is an important consideration when operating upon the organ or when it has been severely lacerated or incised. Very severe injuries can often be repaired with excellent results.

The major portion of the blood supply is derived from a branch of the internal pudendal artery which enters the base of the urogenital triangle and splits into the paired bulbo-urethral, dorsal, and cavernous arteries (Fig. 12). The bulbo-urethral arteries accompany the urethra to the glans where they anastomose with the terminal branches of the dorsal arteries. The dorsal arteries pass along the dorsum of the penis between Buck's fascia and the tunica albuginea in company with the dorsal nerves and veins. In addition to twigs to the fascia of the penis and anastomotic branches to the erectile bodies, it supplies the glans penis. The main supply to the corpora cavernosa is from the cavernous arteries which enter the cavernous bodies about where the crura unite and traverse them somewhat eccentrically to the median side of their axis. The penis also receives superficial arteries from the external pudic branches of the femorals and small branches from the superficial perineal arteries. The skin of the terminal portion of the penis including the prepuce is supplied chiefly by branches from the dorsal arteries.

The veins consist of a superficial and a deep group. The superficial veins empty for the most part into the superficial dorsal vein which passes back beneath the skin to the pubis and either divides into branches which enter the internal saphenous or femoral veins on each side or joins the deep dorsal vein of the penis. The deep dorsal vein begins above the corona by the union of two branches which receive blood from the glans and prepuce and courses along the dorsum of the penis in the groove between the corpora cavernosa and beneath the deep fascia It receives tributaries from all three erectile bodies. At the base of the penis it passes between the superficial and deep parts of the suspensory ligament. This vessel continues beneath the subpubic ligament, divides into two branches, and terminates in the periprostatic plexus.

The nerves of the penis follow practically the same course as the arterial supply. They are supplied by branches of the perineal nerve which arise from the internal pudendal There are also sympathetic fibers to the blood vessels and muscle of the erectile tissue from the hypogastric plexus through the prostatic plexus to the cavernous plexus where they join the dorsal nerves of the penis for distribution.

The penile lymphatics are particularly important in relation to carcinoma of the penis. They are collected into two main groups. The superficial group begins within the skin of the prepuce and frenum and forms channels which accompany the superficial dorsal vein. They receive branches from the entire skin of the penis and drain into the iliac nodes. The deep group begins as a network in the glans penis and forms channels that accompany the deep dorsal vein. They receive branches from the deep structures of the penis and drain into the inguinal nodes and from there to those along the external iliac vein. In some cases the lymph drainage from the penis is to nodes located over Scarpa's triangle (Fig. 11).

THE SCROTUM

The scrotum, which contains and protects the testicles and the distal portion of the spermatic cords, is composed of skin, muscle, and connective tissue. The skin is thin and elastic, and normally thrown into folds. It is usually deeply pigmented, thinly covered with hair, and contains numerous large sebaceous glands. The surface of the scrotum is divided into two lateral halves by a slight ridge, the raphe, which is continuous with the raphe on the ventral surface of the penis and extends backward to the anus. The raphe overlies the muscular septum which divides the scrotum into two pouches, one for each testicle and its covering (Fig 14).

The dartos muscle immediately beneath and intimately associated with the skin is a smooth, thin layer of involuntary muscle and fascia, best developed in front and at the sides. It is continuous posteriorly with the superficial perineal or Colles' fascia, in front with the suspensory ligament of the penis and fascia of the abdomen and groin, and is attached to the ischiopubic rami at the sides. This arrangement of the dartos layer explains the extension of periurethral phlegmon and extravasation of urine from the perineal area into the scrotum and the subcutaneous cellular area of the abdomen. The septum which divides the scrotum into right and left pouches is derived from the dartos and limits a scrotal effusion to the space in which it arises. The dartos is the contractile portion of the scrotum. Its fibers are placed at right angle to the fibers of the derma, which explains the tendency of the skin edges of the scrotum to turn in when incised and require special care in suturing. Beneath the dartos is a layer of loosely constructed connective tissue (Cowper's fascia) which permits the testicles and their fascial investments to move freely within the scrotum and to be easily separated from the scrotum when the skin and dartos have been divided. It is within this loose tissue that extravasations from the perineal portion of the urethra accumulate, and it is the area through which infection and extravasated urine extend upward beneath the skin of the abdomen.

The blood supply of the scrotum is derived from the external and internal pudic arteries and the cremasteric branch of the deep epigastric artery. The veins accompany the corresponding arteries. The nerves are the ilio inguinal, the superficial branch of the internal pudic, the inferior pudendal branch of the small sciatic, and the inguinal branch of the genitocrural. The lymphatics of the scrotum drain into the inguinal and femoral nodes.

The spermatic cord is the pedicle of the testicle. It extends from the internal abdominal ring through the inguinal canal into the scrotum and is connected to the posterior surface of the testicle (Figs 14 and 16). The structures comprising the spermatic cord are the vas deferens and the blood vessels, nerves and lymphatics of the cord, and testicle. The structures are held together by loose connective tissue and incased in a sheath composed of the same muscular and fibrous structures that cover the testicle. The portion of the cord lying within the inguinal canal is readily exposed by dividing the skin, superficial fascia, and the aponeurosis of the external oblique muscle by an incision parallel to

and about an inch above Poupart's ligament. Below the external ring the cord may be exposed by an incision through the anterior surface of the scrotum. The incision most frequently employed to expose the cord in this area begins about an inch below the external inguinal ring and extends downward a sufficient distance for adequate exposure. The median raphe of the scrotum is a much less vascular area and an incision extending downward from the penoscrotal junction gives easy access to the scrotal portion of the cord.

THE TESTICLES

The testicles with their closely attached compact masses of collecting tubules, the epididymides, are loosely suspended within the scrotum by the spermatic cords and their investing tunics and are attached to the base of the scrotum by the remains of the gubernacula testis, the scrotal ligaments (Fig. 16) These ligaments must be divided before the testicles can be delivered from the scrotum.

The testicles are oval grayish white bodies, normally about equal in size, composed of the seminiferous tubules incased in a dense sheath. The tunica albuginea is prolonged inward to form septa that divide the gland into conical lobules of varying size and number. Within these lobules the seminiferous tubules are supported by a fine network of fibrous tissue. At the apex of these lobules the tubules unite to form twenty or thirty tubes, the vasa recta, which enter the mediastinum testis and form an irregular plexus, the rete testis From this plexus twelve to twenty tubules called the vasa efferentia emerge and enter the head of the epididymis The testicles are oval in shape and weigh twenty to thirty grams. The average dimensions are 1½ inches long, 1¼ inches anteroposteriorly and 1 inch laterally. The anterior and lateral surfaces are free and covered entirely by the visceral layer of the tunica vaginalis. The posterior surface is covered partly by the visceral layer of the tunica vaginalis and partly by the epididymis (Fig. 14)

THE EPIDIDYMIDES

The epididymides are long narrow structures originating at the apex of the testicle where the ductuli efferentes pierce the tunica albuginea. They consist of three portions, (1) the globus major or head, (2) the corpus or body and (3) the globus minor or tail. The 12 to 15 ductuli efferentes become the coni vasculosi, which form the globus major of the epididymis The body of the epididymis which is separated from the testicle by the visceral layer of the tunica vaginalis is composed of the closely packed convoluted canal into which the coni vasculosi empty. The lower portion of the epididymis globus minor is directly connected to the testicle and continues as the vas deferens (Fig. 14)

THE VAS DEFERENS

The vas deferens is a thick-walled, fibromuscular tube lined with ciliated columnar epithelium. It ascends from the tail of the epididymis lying behind the vessels of the spermatic cord. At the internal abdominal ring it passes

downward behind the bladder, crosses the ureter, and joins the duct of the seminal vesicle to form the ejaculatory duct. Its entire length is about 18 inches (Figs. 9 and 15).

VESTIGIAL STRUCTURES

Several small vestigial structures are found attached to or near the testicle and epididymis. The sessile hydatid of Morgagni, sometimes called the appendix testis, is situated on the anterior base of the superior pole of the testicle near the globus major of the epididymis (Fig. 14). Although described as sessile it is often pedunculated. It is of surgical interest because of the occasional torsion of the pedicle which causes acute pain and tenderness of the testicle similar to, but less severe than, the symptoms of torsion of the spermatic cord. The hydatid of Morgagni represents the remains of the cranial ends of the Mullerian ducts.

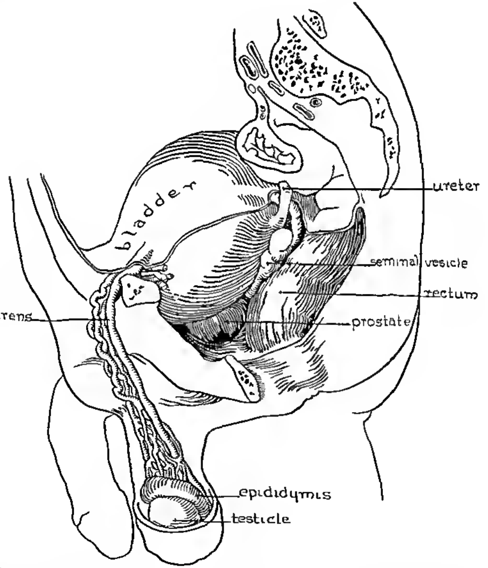

Fig. 16.—Longitudinal section through the male pelvis showing the relation of the pelvic genital organs to the bladder and of the bladder to the rectum. An outline of the cord and testicle is also shown. (After Spalteholz. Hand Atlas of Human Anatomy. J. B. Lippincott Company, publishers. English translation.)

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of striped muscles It covers the cord and testicle and is attached to the dartos layer opposite the lower extremity

The External Spermatic Fascia—The external spermatic (intercolumnar) fascia is the outer covering of the testicle and the scrotal portion of the spermatic cord At the external inguinal opening it converges with the fibrous bands that arch over the external inguinal ring

The Arteries—Each testicle and epididymis is supplied by three arteries which descend as a part of the spermatic cord and give off branches to the structures of the cord (Fig 14) The internal spermatic which is the principal artery of the testicle arises from the aorta just below the renal arteries and, after supplying a branch to the ureter, enters the inguinal canal with other structures of the cord and joins the testicle on the medial side of the body of the epididymis A small branch goes to the head of the epididymis The deferential artery is a branch of the superior vesical It accompanies the vas deferens and supplies the lower portion of the epididymis The cremasteric artery is a branch of the deep epigastric and runs in the sheath of the cord to the lower pole of the testicle and epididymis

Anastomosis is known to occur between the three arteries supplying the epididymis and testicle and theoretically if one is preserved the blood supply should be maintained Practically division or ligation of the spermatic artery results in atrophy or necrosis of the testicle in most cases

Veins—The veins emerge from the testicle and epididymis and run a parallel course with the arteries The spermatic vein forms the pampiniform plexus which is remarkable for the number, size and tortuosity of the venous trunks and their tendency to become varicose (Fig 14) There is an anterior or spermatic group surrounding the spermatic artery and a posterior or deferent group more intimately associated with the vas deferens The anterior group is usually involved in varicocele When operating for varicocele the surgeon must be careful to avoid the spermatic artery The plexus terminates at the internal ring in a single trunk which enters the renal vein on the left side and the vena cava on the right The entrance of the vein at the right angles to the renal vein on the left and the occasional absence of a valve on this side are considered contributing factors to left sided varicocele

The Lymphatics—The lymphatics of the testicle and epididymis pass upward within the spermatic cord and enter the preaortic lymph nodes There is no lymph drainage from the testicle epididymis or tunica vaginalis to the inguinal nodes These are originally intra abdominal structures and retain their original intra abdominal connections This fact is important in the treatment of malignant disease of the testicles and cord

Nerves—The nerves of the testicle accompany the spermatic artery and vas deferens and arise from the renal and aortic sympathetic plexuses

THE PROSTATE

The prostate is a musculoglandular organ situated between the neck of the bladder and the triangular ligament and surrounding the first portion of

The appendix epididymis or pedunculated hydatid when present is attached to the globus major of the epididymis. They are regarded as detached efferent ducts The paradidymis, or organ of Giraldès, is a small body composed of a group of rudimentary tubules situated in the lower portion of the spermatic cord, just above the globus major (Fig. 14). It is a remnant of paragenitalis or remains of the Wolffian body. Cysts arising from these tubules appear separate from the testicle or epididymis.

The vasa aberrantia of Haller are small bodies located in the middle of the epididymis and testicle and are vestigial remnants of the Wolffian duct.

The superior vas aberrans, when present, is an anomalous vas efferens from the rete testis which instead of becoming one of the coni vasculosi ends blindly. These blind ducts are the usual cause of spermatocele.

THE TESTICULAR TUNICS

As the testicles descend they become invested with peritoneal and fascial coverings which permit pliability and freedom of motion, thereby affording considerable protection against injury. The coverings are independent on the two sides and are derived from the following sources. the tunica vaginalis from the peritoneum; the infundibuliform or internal spermatic fascia from the transversalis muscle; the cremasteric fascia from the internal oblique muscle and the intercolumnar or external spermatic fascia from the external oblique muscle.

The tunica vaginalis is the lower end of the tube of peritoneum which is carried into the scrotum with the testicle. The inner or visceral layer is closely attached to the testicle and epididymis investing them completely except small areas at the head and tail of the epididymis where the two organs are in contact and posteriorly where the vessels and nerves of the cord enter and emerge toward the lateral surface of the testicle the visceral layer dips in between the testicle and epididymis forming a pocket, the sinus epididymis. The outer or parietal layer of the tunica vaginalis lines, and is closely adherent to, the infundibuliform fascia. A potential cavity exists between the parietal and visceral layers of the tunica vaginalis. When this cavity is distended with fluid it is known as a hydrocele. Normally that portion of the peritoneal tube above the testicle becomes obliterated and remains as a thin fibrous structure among the contents of the spermatic cord Failure of this tube, the funicular process, to become obliterated may permit the formation of a congenital hernia or hydrocele. Incomplete obliteration may result in a hydrocele of the cord when the central portion remains patent or hernia when the tube remains patent to the peritoneal cavity.

The Internal Spermatic Fascia.—The internal spermatic (infundibuliform) fascia is a delicate layer of connective tissue which closely invests the elements of the cord and testicle It is the immediate covering of the tunica vaginalis with which it is closely fused.

The Cremasteric Fascia.—The cremasteric or middle fibrous layer is composed of strong laminae of areola and elastic tissue interspersed with bundles

CHAPTER II

DIAGNOSIS

There is no other branch of surgery in which a more accurate diagnosis is possible than in urology, nor in which preoperative and postoperative treatment offers so much in reducing the hazards of operation. The diagnosis of diseases of the genitourinary organs is reached by coordination of the history, the general examination, the external examination of the urogenital organs, laboratory tests, and, when necessary, by x-ray and cystoscopic examinations.

History

A thorough history is the first step in arriving at an accurate diagnosis. It should include the chief complaint and present illness, the past history, and the family history of the patient.

The patient suffering with surgical disease of the genitourinary tract usually complains of pain, hematuria, tumor, or disturbance of the bladder function.

Pain.—It is essential to note the character and location of the pain, its duration and the circumstances that influence it. Dull aching pain in the lumbar region, increased by exercise, is often caused by chronic inflammation or distention of the kidney such as in tuberculosis, hydronephrosis or large calculi with infection. Acute cutting pain beginning near the costovertebral angle or in the upper quadrant of the abdomen and radiating downward along the course of the ureter indicates an obstructive lesion in the kidney pelvis or ureter, usually a movable stone. Chronic obstruction of the ureter such as a kink or stricture causes continuous dull pain in one or both sides of the lower abdomen, often radiating to the opposite side or down the leg and, in women, more severe during menstrual periods. Ureteral lesions both acute and chronic are often accompanied by frequency of urination. Dull pain in the hypogastrium may be caused by cystitis, stone, or distention of the bladder. Patients with large Hunner's ulcers usually complain of severe suprapubic pain. Dull pain in the inguinal region, over the sacrum, or in the perineum, most frequently indicates inflammation of the prostate or seminal vesicles. Perineal pain is often severe in prostatic calculi and acute infections of the gland. In acute epididymitis pain and tenderness may be felt in the groin before attention is called to the epididymis. Pain in the anterior urethra often results from inflammation of the prostate or bladder sphincter area. Stone in the bladder frequently causes severe pain along the anterior urethra and in the glans penis. When stone is present both pain and frequency of urination are increased by exertion.

the urethra. Its apex is situated forward and its base toward the rectum from which it is separated by an extension from the pelvic fascia, the fascia of Denonvilliers (Fig 9). It weighs from 16 to 24 grams and is about one and one-half inches in its longitudinal and transverse dimensions and three-fourths of an inch thick. The ejaculatory ducts enter the base of the gland at its postero-lateral angles and emerge on each side of the orifice of the utricle (Figs 9 and 10). That portion behind the ducts is known as the posterior lobe; the portion in front of them is divided into two lateral lobes, and an anterior and median lobe. The prostate contains both longitudinal and circular fibers which are intimately connected with the musculature of the bladder. The circular fibers surround the urethra. The glandular structure is composed of compound tubular glands supported by a fibromuscular network. The glands form about twenty ducts which enter the urethra on each side of the verumontanum. The prostate is encased in a dense fibrous capsule and is supported by the puboprostatic ligaments and the anterior fibers of the levator ani muscle. Its arteries are branches of the internal pudic, middle hemorrhoidal, and inferior vesical. The veins after forming a plexus on the sides and base enter the internal iliac vein The nerve supply comes from the hypogastric plexus.

THE SEMINAL VESICLES

The seminal vesicles, two in number, lie above the prostate, adherent to the base of the bladder, and are separated from the rectum by the fascia of Denonvillier (Fig. 9). Each vesicle consists of a thin-walled fibromuscular tube, four to six inches in length, closed at one end and coiled upon itself to form an irregular, crescent-shaped pouch, about an inch and a half long, and flattened anteroposteriorly. The vasa deferentia pass along the base of the bladder between the seminal vesicles and unite with the ducts of the vesicles at the base of the prostate to form the ejaculatory ducts.

The arteries are branches of the inferior vesical and middle hemorrhoidal. The veins accompany the arteries and join the prostatic plexus The lymphatics drain into the iliac nodes, and the nerves come from the hypogastric plexus.

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Disturbance of the Bladder Function—Frequency of urination, dysuria, difficult urination and incontinence of urine comprise the largest number of urological complaints The causative lesion of frequency of urination may be found in any part of the urinary tract or related organs

Strictures, inflammation or stone in the ureter at times cause symptoms characteristic of cystitis Unless there is an accompanying pyelitis the urine will be clear The accompanying symptoms of abdominal pain and tenderness on pressure over the lower ureteral areas should aid in the diagnosis The earliest and most predominating symptom of tuberculosis of the kidney is frequent and painful urination, but in these cases even very early, there are always pus cells and often blood Furthermore, careful examination will often determine the presence of tubercle bacilli in the patient's urine

The earlier stages of obstruction from lesions either at the bladder orifice or in the urethra are solely those of bladder irritability, and when infection is added, cystitis persists until the obstruction is relieved In the first two decades of life obstruction is apt to be caused by congenital lesions, such as stenosis of the urethra, most frequently at the meatus, valves of the posterior urethra, enlargement of the verumontanum or by fibrosis of the internal sphincter area Between the ages of 20 and 40, inflammatory strictures of the urethra predominate, between 40 and 60 years of age, men are more apt to suffer from fibrosis and median bars at the bladder orifice, resulting from long standing infection of the prostate gland In men past 60 years of age, benign and carcinomatous hypertrophies of the prostate produce the majority of obstructive lesions in the ratio of about four benign to one malignant As these diseases progress difficulty in voiding and straining at urination add to the patient's discomfort

Difficult Urination and Incontinence—Difficult urination and retention of urine are most frequently due to obstruction In children and adolescents, stenosis of the meatus and congenital valves are the usual cause, in young adults urethral strictures should be suspected and as age advances fibrosis, hypertrophy and carcinoma of the prostate are most frequently encountered Difficult urination is accompanied by pain when infection occurs Neurogenic disturbances of the bladder occur in syphilis of the central nervous system, sclerosis of the spinal cord, congenital defects and inflammation of the spine and following spinal injuries Bladder paralysis often comes on so insiduously that the bladder is overdistended and incontinence occurs before the patient is aware of the trouble In most cases of paralysis of the bladder difficult urination is accompanied by frequency and in some cases by incontinence

Incontinence occurs regularly in such congenital conditions as exstrophy of the bladder advanced epispadias, and congenital absence or lack of development of the urethral sphincter In adults it occurs following advanced strictures, chronic complete retention of urine from prostatism or paralysis paralysis of the sphincters caused by injury or disease, and from fistulas after bladder injury Retention of urine is rare as a result of uncomplicated stricture In most instances, even though the stricture is filiform in size the bladder can

Hematuria.—The appearance of blood in the urine is so often an indication of serious pathological changes that a thorough urological study is always indicated, except in those cases in which the source of the blood is clearly shown by associated signs and symptoms. Profuse bleeding most frequently occurs in tumors of the kidney or bladder, prostatic hypertrophy and trauma. Bleeding from tumors of the kidneys or bladder is usually spontaneous, both as to onset and termination, and may recur in a few days, or after several weeks. Pain in the kidney or kidney colic may result from the passage of clots, or from a movable, palpable kidney as well as from a stone. Bleeding may be the only symptom of tumor of the bladder or may follow a history of frequency of urination, while the age of the patient and the size of the prostate are suggestive of prostatism when the patient complains of no other symptoms than hematuria. Following trauma the significance of bleeding is evident from the history.

Profuse bleeding occasionally occurs as an early symptom of tuberculosis of the kidney. More frequently, however, the bleeding in tuberculosis is less abundant, giving a smoky appearance to the urine, and is accompanied by painful, frequent urination.

Bleeding from stone in the kidney may be sufficient to turn the urine red or port wine color, and may persist for several days; usually it is microscopic in amount or tinges the urine following an attack of kidney colic.

Polycystic and hydronephrotic kidneys bleed intermittently and sometimes quite freely In the former an irregular enlarged kidney can be palpated. Often there is bilateral enlargement. High blood pressure, albuminuria and diminished kidney function are usually present. Hydronephrosis often causes a dull pain in the kidney region and a smooth elastic tumor may be felt.

The bleeding from stone in the bladder is never excessive, and is accompanied by tenesmus and frequency of urination. These symptoms are exaggerated by exertion.

In nephritis and in the so-called essential hematuria the urine may be colored by dark blood for days at a time Other symptoms of nephritis may be present, or the diagnosis is made by exclusion.

Bleeding from the anterior urethra may be caused by tumor or trauma It occurs independently of urination or the blood is washed out at the beginning of the act.

The bleeding of acute cystitis and acute infection of the prostate and posterior urethra is terminal and accompanied by pyuria, tenesmus, and straining

Blood in the urine is often noted in hemophilia, purpura, polycythemia, rubra vera, leukemia, Hodgkin's disease, and in many acute infectious diseases A thorough history, physical examination and examination of the blood often serve to determine the diagnosis. Hematuria does not always indicate a surgical lesion, but a thorough urological study should be made in all cases in which the cause is not clearly understood

Tumor.—Tumor or swellings of the organs of the urogenital system are often first noticed by the patient With the exception of inflammatory diseases of the external genitals, they usually indicate serious pathological processes They will be discussed in the section on external examination.

and sharp percussion over the costolumbar angle with the fingers of the opposite hand, tenderness of the inflamed kidney may be elicited or the kidney may be made to rebound against the anterior hand as in fetal ballottement. Kidneys that are ptosed or extremely movable may be felt and moved about occasionally as low as the iliac fossa. It is usually difficult by palpation alone to determine the cause of enlargement of the kidney. A smooth elastic mass suggests solitary cyst or hydronephrosis. A pyonephrotic kidney is tender and fixed in position. In thin patients many nodules may be felt over the surface of a polycystic kidney and the opposite kidney may also be palpable. Tumors of the kidneys are usually firm, slightly movable and painless. Intraperitoneal masses are as a rule more central, displace the colon outward rather than inward as kidney tumors do and are often more movable.

The Ureter.—The ureter cannot be palpated except when greatly enlarged. In very thin individuals definite tenderness of an inflamed ureter may be elicited by pressure over the abdomen to the inner side of the crest of the ilium, over the upper part of the anterior vaginal wall in the female and just above the prostate between the seminal vesicles in the male.

The Bladder.—The distended bladder may be palpated as a smooth globular mass in the hypogastric region and pressure above the pubis elicits tenderness when the bladder is inflamed. The base of the bladder may be palpated through the rectum, and the induration of advanced malignancy or the doughy tender masses or perivesical inflammation or extravasation recognized. In thin adults and in children stones are sometimes palpated in the bladder by bimanual palpation with a finger in the rectum and a hand over the suprapubic area. Retention of urine in the bladder may be recognized by percussion when the distention is not great enough to be felt.

The Spermatic Cords and Testicles.—Palpation is a valuable means of diagnosing pathological conditions of the cords and testicles. These structures are gently manipulated between the thumb and fingers. The thick doughy mass of a hernia is readily differentiated from the multiple tortuous elastic cords of varicocele. A spindle shaped elastic mass along the course of the cord is usually a hydrocele of the cord, and a globular mass just above but distinctly separated from the testicle is readily recognized as a spermatocele. A hydrocele of the testicle surrounds the organ except posteriorly, is painless, elastic or fluctuant, and usually transmits light. The normal testicle is ovoid, tense and smooth, and on pressing it a sickening sensation is experienced by the patient. The normal epididymis lies posterior to the testicle, is flaccid and slightly sensitive on palpation. The vas deferens is smooth and cordlike. When acutely inflamed the epididymis becomes thickened, tense and exquisitely tender, and fits over the posterior portion of the testicle like a crescent shaped helmet. In fulminating types of infection the edema of the scrotum and inflammatory hydrocele prevent differentiation of the epididymis from the testicle by palpation.

Chronic enlargements of the testicle are gumma, malignant or benign tumor, tuberculosis and chronic infection. Gumma is characterized by the

be emptied by constant straining and dribbling. In my opinion residual urine from stricture is usually an acute process resulting from edema and complete closure of the strictured area.

General Physical Examination

Even though the disease may be clearly confined to the urogenital tract, a careful physical examination should never be omitted. Nephritis, polycystic kidneys, and prostatic obstruction are often associated with high blood pressure, while a crippled heart influences the treatment in many urological cases. The condition of the lungs is important in determining the patient's chances of surviving an operation, and as a diagnostic aid in probable tuberculosis and in some tumors of the kidney. The condition of the digestive system influences the administration of drugs and has a marked effect on the prognosis in many urological cases.

External Examination of the Urogenital Tract.—The external examination consists of inspection, palpation, and percussion.

Inspection.—By carefully looking at the patient with the clothing removed, a great deal of information can be obtained. The sallow, emaciated old man with a history of frequent and difficult urination will be suspected of having carcinoma of the prostate. The dry parched tongue often indicates approaching uremia and edematous ankles suggest decompensation of the heart or nephritis. Tumors of the kidneys may give a fullness to the flank or a rounded elevation in the abdomen. Inflammation about the kidney will often cause a lagging of the respiratory movements on the affected side. A perinephritic abscess frequently shows definite bulging on the affected side as compared with the opposite flank especially when the patient sits up and leans forward.

The overdistended bladder often presents a distinct rounded swelling above the pubis. Hernias may be recognized by inspection, and enlargement of the contents of the scrotum is obvious. Redness of the scrotum indicates an acute inflammatory process, while enlarged veins coursing over the surface suggest malignancy. Congenital lesions and ulcers of the penis often present a characteristic appearance The flattened glans and hoodlike prepuce of hypospadias is readily recognized Localized swellings about the perineum or undersurface of the penis with tenderness, pain and fever and disturbances of urination and infected urine can be none other than abscesses arising from the lower urinary tract.

Palpation and Percussion.—*The Kidney*—The kidney is more easily palpated with the patient flat on his back and the legs drawn up to relax the abdominal muscles. The examiner stands or sits by the patient's side One hand is placed posteriorly with the fingers in the angle formed by the costal margin and the lumbar muscles, the other hand is placed just external to the linea semilunaris, with the tips of the fingers just beneath the ribs Gentle but firm pressure is made by both hands while the patient breathes slowly and deeply. The kidney that is slightly enlarged or slightly ptosed may be felt to slip between the fingers during respiration With the anterior hand in place

The Penis.—By palpation of the penis, areas of thickening and induration are recognized. Localized fibrosis in the sheaths of the corpora cavernosa is felt usually along the dorsum of the penis as movable parchment like thickened areas, with rather sharp clearly defined margins. Ulcers can be palpated beneath a phimosis. Palpation of the urethra is carried out over a sound which just fills the urethra. Areas of thickening in strictured areas and indurated and occluded urethral glands are felt as shotlike bodies along the under surface of the urethra.

Preoperative Urological Examination

Urological surgery is rarely an emergency, and except in a very occasional instance, will permit complete preoperative study by all the means now at the command of the urologist.

This preliminary investigation should embrace the entire urinary tract, and it should be recognized as a cardinal principle in this field that no major surgery should be undertaken until the condition of the urinary organs are thoroughly understood.

The kidneys and ureters can be accurately visualized by instrumental or by intravenous pyeloureterography. When cystoscopic examination is not advisable, the contour of the bladder, together with diverticula, tumors or an enlarged prostate, can be accurately outlined by an X-ray examination following the introduction of a contrast substance. Many urologic conditions formerly requiring operation are now relieved by modern cystoscopic methods while irrigation and drainage of an infected kidney containing a stone by indwelling ureteral catheters diminish the infection, lessen the hazard of operation and often make possible a nephrostomy or pyelostomy when otherwise a nephrectomy would seem indicated.

The Kidney

If the kidney is the site of disease many interesting problems present themselves. It is necessary to know the functional capacity of each kidney and to estimate the recuperative power of the diseased kidney should palliative measures be adopted. A comprehensive study will disclose the condition of the sound side, the nature of the processes at work in the diseased side, and the most appropriate measures for this relief. It will also not infrequently suggest preliminary treatment over a longer or shorter period, during which period essential changes may occur, making less surgery sufficient, or no surgery necessary, or more surgery possible.

A severe pyelitis or an impacted stone will often cause temporary suppression of function from one kidney, which function will be resumed if the cause is removed. By too hasty action in such cases a useful kidney may be sacrificed.

Unexpected pathology, operative accidents, or extreme technical difficulties may require nephrectomy where some simpler procedure had been planned,

excessive weight of the mass, woody hardness, loss of sensation and a positive Wassermann test. Malignant tumor grows more rapidly, may be slightly sensitive, is often irregular in outline with areas of softening, and, while much heavier than hydrocele or inflammatory masses, lacks the excessive weight of a syphilitic testicle. Chronic inflammatory disease is usually confined to the epididymis. The epididymis is indurated, often nodular, slightly sensitive, and can be distinctly differentiated from the testicle. In tuberculosis the vas deferens may be nodular on palpation, the epididymis is often more nodular than the chronically inflamed epididymis, and frequently presents softened or fluctuant areas. Sinuses to the scrotum, or involvement of the testicle are not unusual in tuberculosis

The Prostate and Seminal Vesicles.—The prostate and seminal vesicles are palpated through the rectum. The patient may lie on his back with his thighs flexed on his body, or bend forward resting his body on a low table or his elbows on his knees. The index finger protected by a finger cot or glove is inserted into the rectum. With the thumb pressed against the perineum the membranous urethra and the perineum can be palpated by the finger. The normal membranous urethra is felt as a barely perceptible flattened cord leading up to the apex of the prostate. Areas of induration or periurethral infiltration are readily recognized. The normal perineum is thick, smooth, and resistant. Induration or enlargement of Cowper's glands is felt on either side of the urethra in the perineum. The normal Cowper's glands cannot be palpated The finger is then inserted higher and passes over the prostate The normal prostate is flat, movable, heart-shaped, mildly sensitive, and presents a notch in its upper border and a barely perceptible groove down the center separating the lateral lobes The inflamed prostate is more rounded, acutely sensitive, and except when greatly enlarged the median groove is more distinct. Periprostatic thickening and irregularity of the surface indicate pronounced chronic inflammation. Decisions regarding inflammation of the prostate should not be made on palpation alone. Often the fluid expressed from an apparently normal prostate will contain numerous pus cells The tuberculous prostate is hard, irregular and nodular. Frequently it must be differentiated from chronic inflammation or early carcinoma of the prostate by the history, age of the patient, and other physical or cystoscopic findings. In benign hypertrophy the prostate is enlarged generally, broad and flat or bulging well into the rectum. Often the finger cannot reach the upper border. It lacks the sensitiveness of acute inflammation and the irregularity and brawny hardness of carcinoma In early carcinoma the prostate is nodular and not greatly enlarged. There may be only one rather fixed nodule, usually near the apex. In late cases there is considerable enlargement The gland is irregular in outline, brawny, hard, and fixed to the surrounding tissues Often the induration extends well above the prostate involving the seminal vesicle areas. The normal seminal vesicles cannot be palpated unless distended. When inflamed they may be felt as indurated areas, extending upward and outward from the base of the prostate. The finger may recognize a space between the seminal vesicles or when greatly enlarged a continuous mass is felt above the prostate

Cortical abscesses usually demand nephrectomy There is too much danger of infection and secondary hemorrhage if an attempt is made to resect the diseased portion of the kidney If nephrectomy cannot be done because of poor function in the opposite kidney, the abscess should be drained

Operative treatment should be a last resort in idiopathic or essential hematuria Stripping the capsule and bisection of the kidney have been tried with rather doubtful results Should the bleeding be sufficient to endanger the health of the patient, nephrectomy is the operation of choice

There is usually improvement in the function of the sound kidney following the removal of a markedly diseased one This is not altogether due to work hypertrophy, for often these diseased kidneys have been functionless for months By extirpating the diseased kidney, an extra burden of toxic material is removed from the sound kidney as well as the danger of becoming secondarily infected

Regardless of the pathologic condition existing, surgical judgment must be largely influenced by the functional capacity of the supposedly normal kidney, obtained by the differential function test Phenolsulfonphthalein is usually employed Six milligrams dissolved in 1 c c of water are given intravenously and specimens of urine are collected separately from catheters in each ureter The specimens are collected in bottles containing a few drops of an alkaline solution, so that when the dye appears in the urine the specimen turns red In a normal kidney the dye should appear in the urine in from five to seven minutes, and in the first twenty minutes about 1 per cent a minute should be eliminated Frequently when one kidney has been functionless for a long time its fellow will eliminate as much as 30 per cent of the dye in twenty minutes When one or both kidneys cannot be catheterized or when it does not seem advisable to do so, indigo carmine is useful as a rough indicator of the kidney's function It is given intravenously, and its appearance from the ureters is observed through the cytoscope It appears in about the same time as phenolsulfonphthalein, and a kidney is considered practically functionless if there is no appearance of the dye in twenty minutes

A severe pyelitis or stone in the kidney pelvis or ureter will often cause a marked diminution of function without noticeable destruction of the kidney parenchyma The normal function will be resumed in these cases following the removal of the irritating factor There are other cases in which the symptoms have existed for a number of years and in which a pyelogram shows the kidney pelvis to be markedly dilated with the calvces practically effaced In such cases there is very little hope for improvement in function and nephrectomy is the quickest and the best means of relief for the patient

The Ureter

In recent years the ureter has occupied an increasingly prominent place in the surgery of the urogenital tract The lesions of this tube, usually obstructive in character, are chiefly important because of their interference with the drainage of the kidneys Strictures and stones, the most common lesions,

or the degree of operative traumatism, where nephrectomy is not done, may cause temporary suppression of function in the kidney involved. The burden of sustaining life in the patient is then thrown upon the opposite organ and its actual existence or its freedom from disease cannot be left to hypothesis.

Nephrectomy is usually indicated in tuberculosis of the kidney regardless of the stage of the disease or the function of the diseased organ, if the other kidney is free from infection.

Cases are occasionally seen with a tuberculous bacilluria and with a few red cells and leukocytes in the urine, but with normal kidney function and no structural changes in the pyelogram. Such early cases occasionally heal. If the function of the kidney is diminished, if the pyelogram indicates destruction of tissue or changes in the contour of the ureter, or if there are ulcers in the bladder, cure is dependent upon nephrectomy. In cases in which one kidney is far advanced in disease and causing septic symptoms, and the other kidney mildly infected and having good function, the patient will enjoy improvement in health and longer life if the more diseased organ is removed.

As a general rule, multiple stones in the kidney or recurrent stones require nephrectomy. A more conservative course may be taken if the kidney has good function and there is very little infection or if the opposite kidney is diseased. Pyonephrosis is a very obstinate condition to treat, and, whether it is accompanied by stone or not, if the disease is unilateral, nephrectomy should usually be done

Hydronephrosis, if seen before the function of the kidney has been destroyed, can frequently be relieved by conservative means. If due to twists or kinks of the ureter, adhesions can be broken up and the kidney anchored at a higher level, giving better drainage Obstructing stones may be removed, aberrant vessels divided, and strictures dilated by a bougie passed through the cystoscope.

In selected cases plastic operations upon the pelvis of the kidney or upon the ureter designed to improve drainage may prevent further destruction of the kidney and improve its function. The principle of renal counterbalance, as advocated by Hinman, should be borne in mind; that is, an injured kidney working with a healthy one has not the same stimulus to repair as an injured kidney working alone or when a similar disease exists on the opposite side. Plastic operations are, therefore, more successful when performed upon solitary kidneys or for bilateral hydronephrosis. When there is a normal kidney on the opposite side, it is well to test the diseased kidney's potential function by inserting an indwelling ureteral catheter a few days before operation If the kidney's function is not half that of its healthy fellow and if this function does not improve with adequate drainage, nephrectomy is advisable.

Polycystic kidney is a bilateral condition and nephrectomy is advisable only when secondary disease, such as stone or infection, endangers the life of the patient. Simple cysts of the kidney are associated with interstitial nephritis and are not often bilateral. If the kidney is functioning, it should not be removed.

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are usually treated successfully by cystoscopic methods. Impacted calculi, very dense strictures and those at the ureteropelvic junction, kinks accompanied by adhesions, and injured ureters demand operation for relief. In such instances, it is necessary to have a thorough knowledge of the function of each kidney. Occasionally it will be found that a nephrectomy is the operation of choice. Transplantation of the ureter into the large bowel, into another area of the bladder, or onto the skin is being practiced with increasing frequency because of the more radical methods of treating malignant disease of the bladder.

The Bladder

Methods of examining the bladder consist of catheterization, measuring the capacity, cystoscopy, and x-ray examination, including cystograms and by cystometrograms Disturbances of the bladder function and discomfort when *voiding are so frequently caused by disease of other organs of the genito-*urinary system that a complete urological study is often necessary to locate the pathological process

Catheterization is employed to collect an uncontaminated specimen of urine, to determine the presence and amount of residual urine and to measure the capacity of the bladder. This simple method of examination will often give a valuable lead to the probable cause of disturbed bladder function or painful and frequent urination.

Cystoscopic examination is the most accurate method of making a diagnosis of pathological processes in the bladder. The experienced urologist can determine quite accurately the origin and pathological characteristics of ulcers and tumors in the bladder. The presence of stones, other foreign bodies, and diverticula is recognized and the effect of obstructive lesions and infection on the bladder is determined In elderly patients or those with infection in the prostate or with poor renal function resulting from prostatic obstruction cystoscopic examinations should be done cautiously. In such cases preliminary catheterization to test the "temper" of the urethra, an estimation of renal function, and preliminary medication with urinary antiseptics may prevent a severe reaction with fever, chills or uremia following instrumentation In some cases an x-ray examination including a cystogram will give sufficient information with less danger.

Cystometrograms are useful in determining the presence and nature of neurological disease of the bladder Many cases of incontinence, frequency of urination and retention of urine are accurately classified by this procedure.

The Prostate

The diagnosis of surgical diseases of the prostate can usually be made by methods previously discussed in this chapter. In most cases rectal palpation of the prostate and the determination of the amount of the residual urine give a fairly accurate diagnosis. Cystoscopic examinations in suitable cases or

cystograms in feeble patients with poor kidney function give more accurate information as to the size and character of the enlargement Biopsy is indicated in patients suspected of early carcinoma

The Urethra

Surgical diseases of the urethra are usually recognized by inspection, palpation, and the passage of bougies Urethroscopic examination is indicated to determine the cause of urethral bleeding Early carcinoma of the urethra is occasionally recognized by this method of examination These tumors occur more frequently than is usually recognized Indurated areas and fistulas of the urethra should be carefully investigated when the cause is in the least obscure

The External Genitals

Surgical diseases of the external genitals have been discussed under physical examination The possibility of malignant disease should always be considered when chronic fungating or ulcerating lesions are seen on the genitals When there is doubt as to the nature of the lesion a biopsy should be made Enlargement of the testicle should always arouse suspicion of malignant disease especially when the enlargement is gradual and painless A history of injury is often obtained in malignant disease of the testicle Swelling of the testicle following injury that does not subside within a few weeks should be considered a malignant tumor until proved otherwise

UROGRAPHY

Lawrence O Snead, M D, F A C R

Both retrograde and intravenous pyelography have become so well established as a part of urinary tract investigation that no attempt will be made to justify either, or to prove the advantage of one over the other Either method will, as a rule, give good pyelograms and often one method will give desired information when for some reason the other has failed The ideal method of examination is the routine use of intravenous urography, using the retrograde method to bring out details and demonstrate pathological changes not clearly shown by the intravenous method Because of occasional sensitiveness to the drugs used and at times for economic reasons this is not always practical

With the passing years, the media used for pyelography has changed from time to time The media in general use at present gives good visualization of the kidneys, ureters, and bladder The distress which often occurred in years past with the retrograde method seldom occurs, and bilateral retrograde pyelograms can now be done with safety The intravenous method seldom has any side effects more pronounced than a slight sensation of warmth and sometimes a transient urticaria

It must be remembered, however, that urography is only a part of a complete urinary tract investigation Any comparison here between the intravenous and retrograde pyelogram must be considered as just that, since in the complete investigation many other factors must be worked out

Good visualization of the urinary tract by the intravenous method requires meticulous attention to detail and should begin with preparation of the patient. The patient is told to take a laxative following a light evening meal and not to take anything by mouth for nine hours before the intravenous is to be given The partial dehydration allows a better concentration of the opaque material in the urinary tract, resulting in better visualization of the parts

Using the customary precautions, and one of the sensitivity tests, the medium of choice is injected into a vein at the elbow. Immediately after the dye is injected, a small sheet, folded and tightly rolled so as to fit in between the crests of the ilia, is placed in this position and a rubber compression bag applied over this. The ureters are best compressed at the upper bony outlet of the pelvis, therefore pressure must be fairly high up. The sheet is rolled so as to be a little large on the left side, since the left ureter, due to its anatomical location, is a little harder to obliterate than the right In his way both ureters can usually be almost completely blocked and excellent pyelograms can be obtained Without compression the normal motility in the upper urinary tract causes the dye to be rapidly excreted into the bladder and the pyelograms are usually dim or incompletely filled Such pyelograms are misleading and are often responsible for the oversight of such early lesions as a solitary cyst or small neoplasm, where there is no definite impairment of renal function. When pressure is released and immediate films are made, usually the ureters throughout can be clearly demonstrated Any obstruction will be naturally noted

In the average case the examination is complete in fifteen to twenty-five minutes, but it is important that the films be seen by the radiologist as they are developed, so that further examinations can be directed by him The findings on one film suggest varying techniques, positions of the patient, tube, etc , and the length of time that the kidneys must be watched

Stereoscopic films or those made with the patient on the side, or with the patient lying on the abdomen, may give diagnostic pyelograms obtainable in no other way. A diagnostic film in many instances is obtained in a poorly functioning kidney with obstruction by having the patient return several hours after the usual examination would have been completed

The reason some authors have placed many limitations on the usefulness of the intravenous method of examination—and it is frequently said that early changes in the pelves and calyces cannot be clearly shown—is that they have seen only the poor pyelograms which are produced by an improper technique In the majority of all cases seen there is no excuse for this type of pyelogram today.

In both the intravenous and retrograde methods, an upright film often proves very helpful, since this will show whether the kidney is fixed or mobile The amount of mobility often is an important diagnostic point, showing acute angulation, rotation, delay in emptying, and marked obstruction not seen on a film in the recumbent position

Some of the conditions and types of cases in which intravenous urography is particularly indicated are:

1. When cystoscopy is refused or not advised because of youth or very old age In young subjects such conditions as hydronephrosis, hydroureter, tumors,

and congenital anomaly can be correctly diagnosed without the use of a general anesthetic. The parents' consent to urinary tract investigation is often more readily obtained when the fear of a general anesthetic and the likelihood of reaction from instrumentation are removed.

2. Following extensive pelvic operations where there is a question of some injury to a ureter, and following major bladder surgery.

3. In acute lower genitourinary infection.

4. In accident cases where there is a question of kidney damage.

5. Following plastic operations on the kidney and ureteral implantation.

6. Location of calculi in the urinary tract. Films can be made from many different angles while the pelves and ureters are still filled. Early films show a less dense pyelogram or ureterogram and very dense stones can be seen through it, while later in the examination only fairly opaque or translucent shadows show in the very opaque dense media. This brings out many calculi which are not demonstrable when one strength solution is used, as is necessary in retrograde pyelography.

Due to the fact that one healthy kidney can compensate for slight or grave damage to its mate, one kidney may be slightly or grossly damaged without symptoms directed to the urinary tract. Many times a physician will have a suspicion of something wrong in the urinary tract, but will not feel justified in putting this patient through a general urologic examination.

Frequently excretion urography will disclose unsuspected and unexpected kidney lesions. Just such examinations often demonstrate a large variety of diseases of the kidney, as for instance, malignant or benign tumors, tuberculosis, cortical necrosis of various types, hydronephrosis or hydropyonephrosis from aberrant vessels, stone, etc. Many other conditions, such as horseshoe kidney, unilateral fused kidneys with or without infection and cortical necrosis entirely unsuspected, multiple ureters and kidneys with disease in a pelvis that had not been previously demonstrated by other examinations have been found. Intravenous urograms, made during an attack of renal pain, will occasionally demonstrate pathology that can be demonstrated in no other way. This may be particularly true of temporary pyelectasis resulting from ureteral spasm.

Excretion urography should not be considered a function test, but under normal conditions the kidney begins to excrete the drug very soon after injection, causing an increase in the shadow density of the kidney. This is followed by the visualization of the calices, pelves and upper ureters in about eight to ten minutes. Both pelves should show about the same density and normal cupping of the calyces.

Patients who have been in bed for some time or are having enough pain to require some sedative usually have a large amount of gas in the intestinal tract, and for this reason a retrograde pyelogram is usually of more help than an intravenous.

A retrograde pyelogram is also of more value in most very stout people since they usually have the so called "spider" pelves and there is so much motility in the urinary tract that only dim pyelograms can be obtained intravenously. It is also very hard to get proper compression on the very stout individual.

Good visualization of the urinary tract by the intravenous method requires meticulous attention to detail and should begin with preparation of the patient The patient is told to take a laxative following a light evening meal and not to take anything by mouth for nine hours before the intravenous is to be given The partial dehydration allows a better concentration of the opaque material in the urinary tract, resulting in better visualization of the parts

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three c c of additional fluid is injected As the tips of the catheters are believed to reach the terminal portion of the ureters a film is exposed This usually gives a good outline of the ureters

The patient should be immediately placed in an upright position and a film exposed which will show the amount of renal mobility The patient should then be permitted to sit up or move around for ten minutes and another film exposed When there is normal drainage, the kidneys should be empty, or almost so, in ten minutes Additional films may be made at varying intervals when there is retention to determine the degree and cause of poor drainage

By using gentle manipulation and nonirritating contrast material bilateral retrograde pyeloureterograms are not dangerous and should be done unless one side has been previously visualized by intravenous urography, or the patient is debilitated, with very poor renal function

While pyelograms taken with the patient awake and cooperative are more satisfactory, reasonably good films may be obtained with the patient under anesthesia when taken rapidly and accurately timed between respirations

PRESACRAL OXYGEN INJECTION

Recently a new aid in the diagnosis of retroperitoneal lesions has come into general use In 1948, Ruiz Rivas first described this method of producing a retroperitoneal emphysema by injecting oxygen into the presacral space Following injection, the oxygen dissects up retroperitoneally along the psoas muscles and fills the perinephric spaces Thus, all of the structures involved in this extensive emphysema stand out more clearly on x ray films (Figs 17 and 18) Its principal value lies in visualization of the adrenal spaces When used to demonstrate irregularities of renal outline, more information is derived from the concomitant use of intravenous pyelograms retrograde pyelograms or renal aortography

Previously the only roentgenological technique for more clearly outlining the retroperitoneal space was that of perirenal insufflation described by Carelli in 1921 This procedure never became into wide use, however because of its technical difficulty and the danger of air embolism

Presacral oxygen injection is easy to accomplish with relatively available equipment This procedure gives little discomfort to the patient and the serious complication of air embolism is almost unknown because of the avascularity of the presacral space

Procedure The patient is prepared as well as possible to free the intestine of gas and feces Usually the preceding meal is eliminated and a tenth of a gram of sodium phenobarbital is given beforehand The patient is placed prone on a table jack knifed with the bend at the hips After preparing the skin locally, a skin wheal is raised with 1% procaine halfway between the anus and the tip of the coccyx in the midline With the index finger of the left hand in the rectum as a guide, a No 20 spinal needle is introduced through the skin wheal and directed upward under the tip of the coccyx and then forward along its anterior surface to the sacrococcygeal joint (Fig

In hydronephrosis where there is marked loss of function a retrograde pyelogram usually gives a better anatomical picture. This is also true in cases of glomerular nephritis and in certain cases of tuberculosis. In cases of severe uremia, severe liver disorders, and iodine sensitivity, intravenous pyelograms should not be done.

Whatever the method used, good films are essential, but the value of a roentgen examination depends on the ability and experience of the man reading the films and to a less extent upon the quality of the films.

When a retrograde pyelogram is to be done the patient should be prepared in the same way as for intravenous urography with the exception that water should be permitted in liberal amounts. Usually specimens for examination are collected at the same time, a free flow of urine is desirable and mild sedation should be used to reduce apprehension. I have discontinued the use of opiates as preliminary preparation because of the frequent occurrence of nausea.

The patient should be placed in a horizontal position on the table with the legs placed comfortably in stirrups properly adjusted to leg length. After local preparation and the application of a local anesthetic to the urethra, a cystoscope no larger than is necessary is introduced into the bladder, the bladder is irrigated if necessary to remove cloudy material, the light cord is connected and the bladder inspected as it is gradually filled. It is helpful to locate the ureteral orifices with the observation lens. I have found a No. 6 French olive tip catheter satisfactory; they usually pass easily up the ureters and drain freely. The catheters should be advanced until the tips are believed to rest within the renal pelves This is usually indicated by a rapid drip of urine if the patient is well hydrated. A preliminary film should then be taken and developed while specimens are being collected. If the film shows the catheters in good position, the cystoscope may then be removed, leaving the catheters in place If there are shadows suggestive of stone along the course of the ureters, the patient should be turned slightly toward the side upon which the shadows are noted, and a second film taken. Shadows unrelated to the ureters will be no longer adjacent to the catheter. The contrast substance to be used is then drawn into two ten c c. syringes and adapters attached. The renal pelves should be carefully filled with the solution. The injection should be made with minimal pressure and the patient directed to indicate any discomfort not present when the injection was begun. If there was no evidence of retention within the renal pelves, six or seven cubic centimeters of fluid is sufficient to fill the average renal pelves. If residual was withdrawn, an amount a few cc's less should be introduced. A film should then be exposed and the catheters left in place until it is developed, permitting the retained fluid to drain off.

If the renal pelves are not outlined, it may be necessary to reinject one or both pelves. When the outlines of the pelves are well visualized, the pelves should be gently filled again and the catheters slowly withdrawn as two or

Fig 18 — Adrenal tumor outlined by presacral oxygen

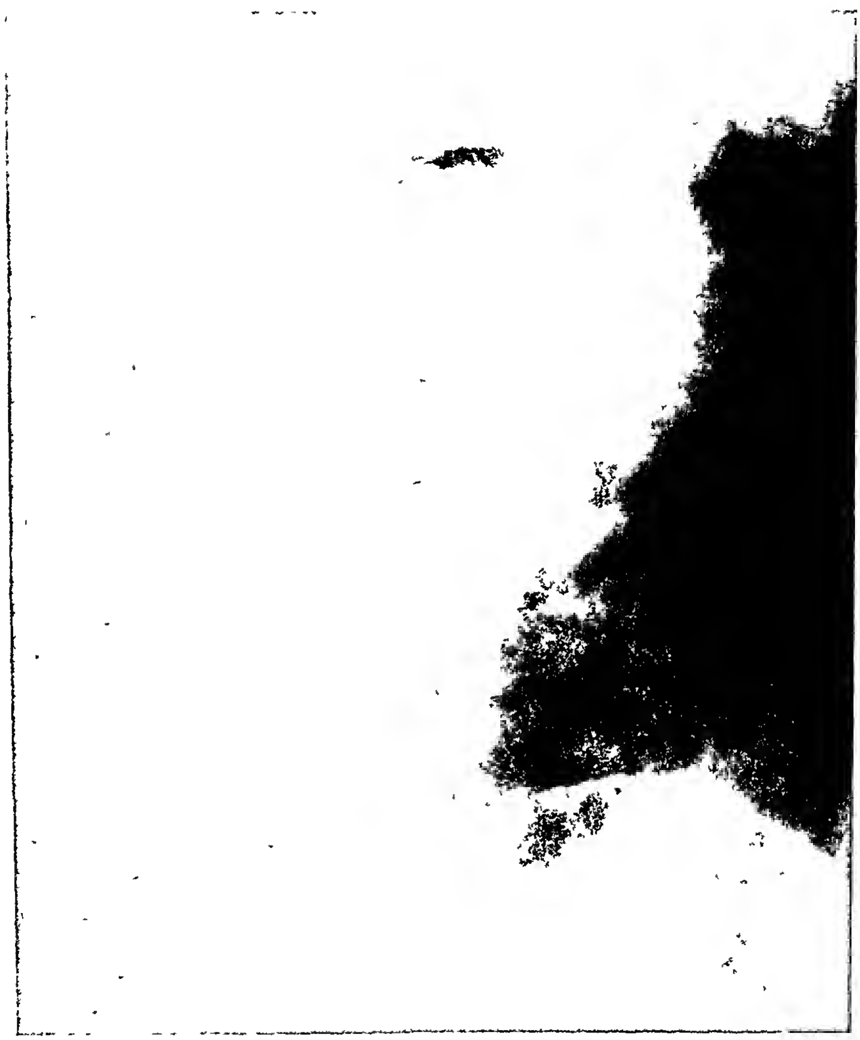

Fig 17—Film showing renal tumor mass outlined by injection of oxygen Note that diagnosis would not be positive with plain pyelogram

Fig 22—Good pyelograms twenty four hours later following good preparation and a second intravenous dye

aberrant blood vessels, tumors, cysts, infarcts, or inadequate blood supply. It is a useful adjunct to other well-established diagnostic procedures. Although large series of cases have been reported without serious ill effects, the procedure is not without danger and should be, in our opinion, reserved for those cases in which additional information is needed to plan an adequate course of treatment.

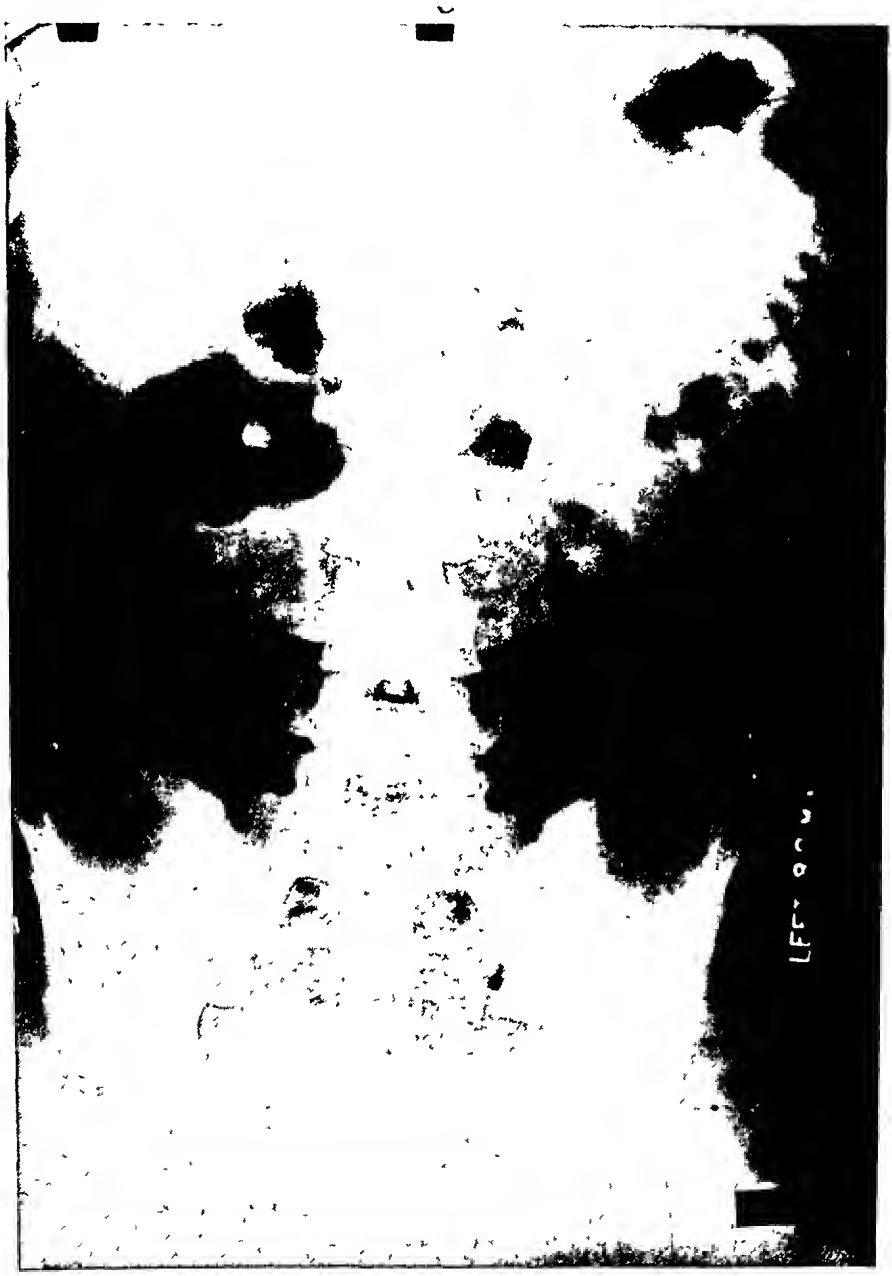

Fig 21 —Failure due to lack of preparation before giving intravenous dye

Figs. 21 and 22 show clearly the advantage of proper preparation in intravenous urography. Figs. 23 and 24 show normal pyelograms by the intravenous

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Fig 26—Failure to demonstrate kidney pelvis on left following intravenous dye

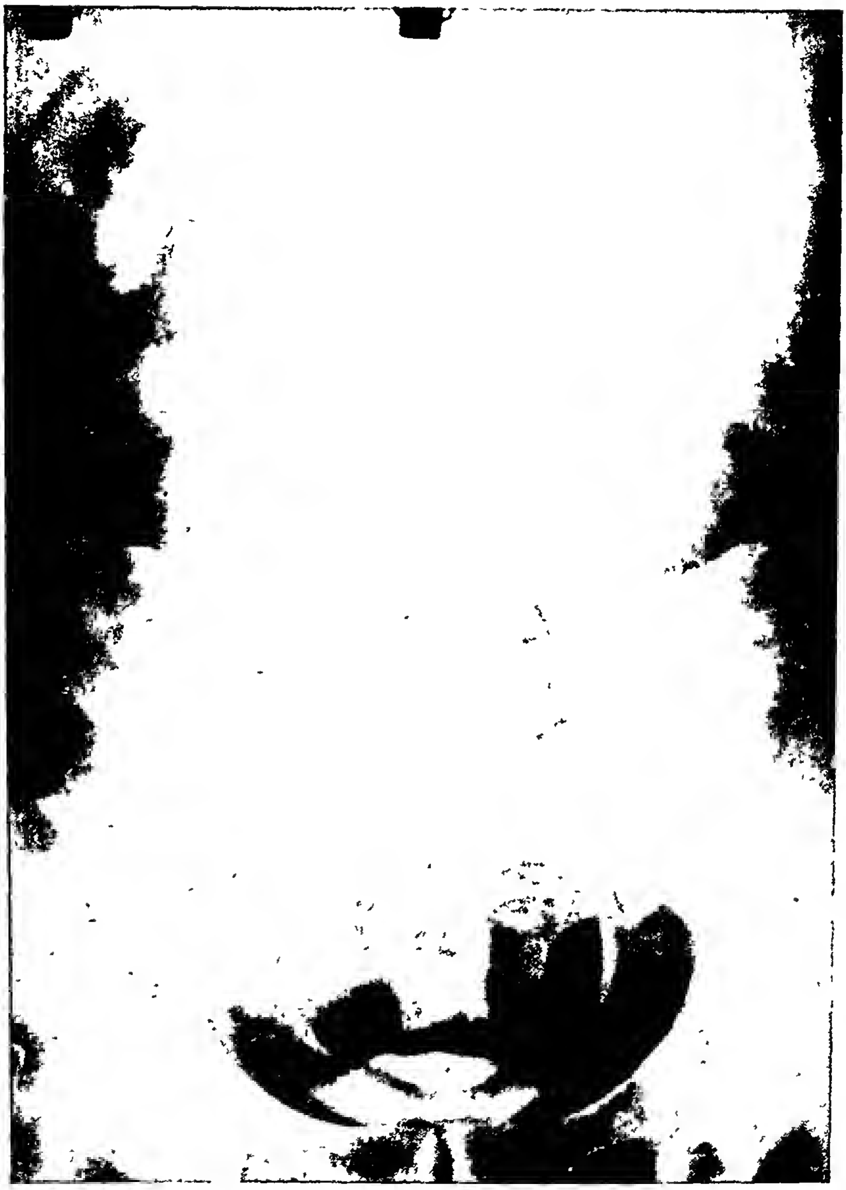

Fig 25 —Normal pyelograms by the retrograde method Film made just as catheters were pulled out

method in an adult and a child Fig 25 shows normal pyelograms by the retrograde method The film was made just after the catheters were withdrawn and the ureters can be seen entering the bladder in the usual position

Fig 26 shows the failure to get a pyelogram on the left side in a poorly prepared patient, although some of the intravenous dye can be seen on the right Fig 27 shows a normal retrograde pyelogram on the left side the next day

Figs 28, 29, 30, 31, and 32 demonstrate congenital deformities clearly by the intravenous method Figs 33 and 34 demonstrate what happens when ureters are transplanted

Fig 28—Double ureters pelves and calyces

Fig 35 shows a proved aberrant vessel by the intravenous method Many retrograde pyelograms often suggest such a vessel, but the catheter has passed into the pelvis, which somewhat straightens out the angulation usually seen In Fig 36 markedly dilated ureters can be easily demonstrated because the obstruction is usually near the bladder In polycystic kidneys the intravenous pyelograms are very diagnostic since they bring out the cortex of the kidney (Fig 37)

In Fig 38 a stone was seen in the upper pole, and intravenous pyelography demonstrated this to be in the isthmus, with blockage and necrosis The stone was probably partially blocking the isthmus and the calyx might not have filled as well by retrograde pyelography

(Text continued on page 83)

Fig 27.—Retrograde pyelogram on the left side the next day, by the retrograde method

Fig 30 —Horseshoe kidney

Fig 31 —Atrophic kidney right side

Fig 29—Unilateral fused kidney, right side

Fig. [illegible] —Exstrophy of bladder, ureters transplanted into sigmoid seven years previously

Fig. 32 —Double ureter on right side

Fig. 3[illegible].—Aberrant vessel right side proved probably also on the left

Fig 34 —Transplantation of ureters

Fig 37.—Intravenous pyelograms showing congenital bilateral polycystic kidneys

Fig 38.—Intravenous pyelograms showing a stone in isthmus to upper calyx with blockage and cortical necrosis

Fig 36 —Enormous dilatation of the ureter as seen on intravenous

Fig 39 is an example of stone in the ureter In Fig 40, because of the patient's age, the urinary tract was suspected, from pain in upper right quadrant Recovery followed removal of gallstones

Figs 41, 42, and 43 show that early tuberculous lesions can be shown well with intravenous and with retrograde pyelograms

Figs 44 45, and 46 are a demonstration of the recuperative power of the kidneys Fig 47 shows pyelitis of early pregnancy Urologist advised conservative treatment, and Fig 48 shows a normal pyelogram soon after delivery Fig 49 shows marked obstruction due to aberrant vessel Fig 50 shows the position of the kidney after operation with the ureter now in position to drain the pelvis Film was made soon after operation and pelvis is still somewhat dilated

Fig 40.—Girl aged 17 Pain upper right quadrant Intravenous urography negative Shows gallstones which were unsuspected

In Fig 51 it seemed at operation that the aberrant vessel was the background of the hydronephrosis Carcinoma can usually be more clearly shown by cystograms, but Fig 52 shows that it is possible to make a diagnosis by the intravenous method, if a cystogram is not possible Inflammatory changes in and around the lower ureter prevented the passage of a catheter in the case shown in Fig 53

Fig 54 demonstrates how much necrosis can be present and still let the patient live a more or less normal life Fig 55 proves that displacements are frequently a valuable diagnostic sign Figs 56 and 57 show tumors of the

(Text continued on page 95)

Fig 39—Stone in lower left ureter as seen on excretory urography

Fig 39 is an example of stone in the ureter In Fig 40, because of the patient's age, the urinary tract was suspected, from pain in upper right quadrant Recovery followed removal of gallstones

Figs 41, 42, and 43 show that early tuberculous lesions can be shown well with intravenous and with retrograde pyelograms

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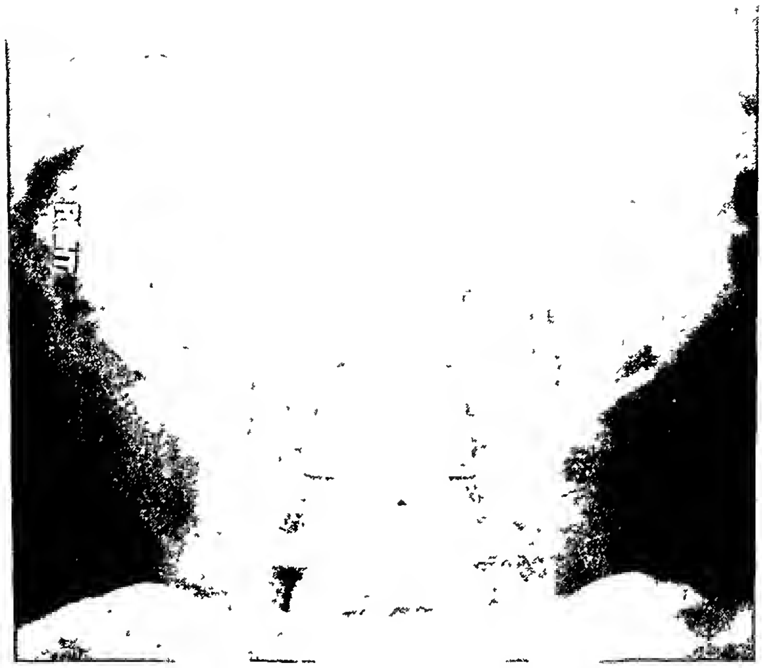

Fig 41 —Intravenous pyelograms showing tuberculous lesion in upper calyx

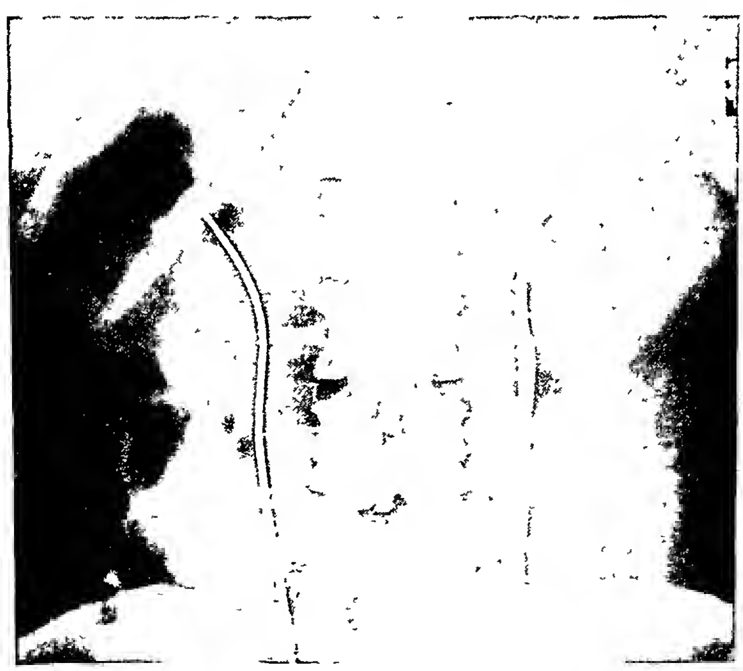

Fig 42 —Retrograde pyelogram showing same pathology as seen on the intravenous film in Fig 41

Fig 43 —Intravenous pyelogram five years later showing increase in pathology Kidney subsequently removed due to marked infection

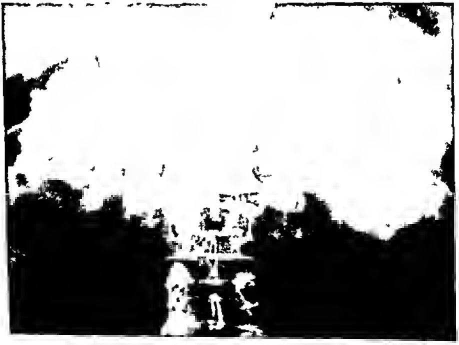

Fig 44 —Intravenous urography shows enormously dilated pelves and calyces Suprapubic drainage was done Nov 30 193

Fig 45.—Improved function with less dilatation was seen on Dec 20, 1937

Fig. 46.—Prostatectomy was done on Jan 7, 1938 A third intravenous, on Jan 26, 1938, shows almost normal pyelograms, demonstrating rapid recovery of the urinary tract following relief of obstruction

Fig 47.—Retrograde pyelogram shows dilated pelvis associated with an early pregnancy. It was feared the pregnancy would have to be terminated but under conservative treatment she went to term

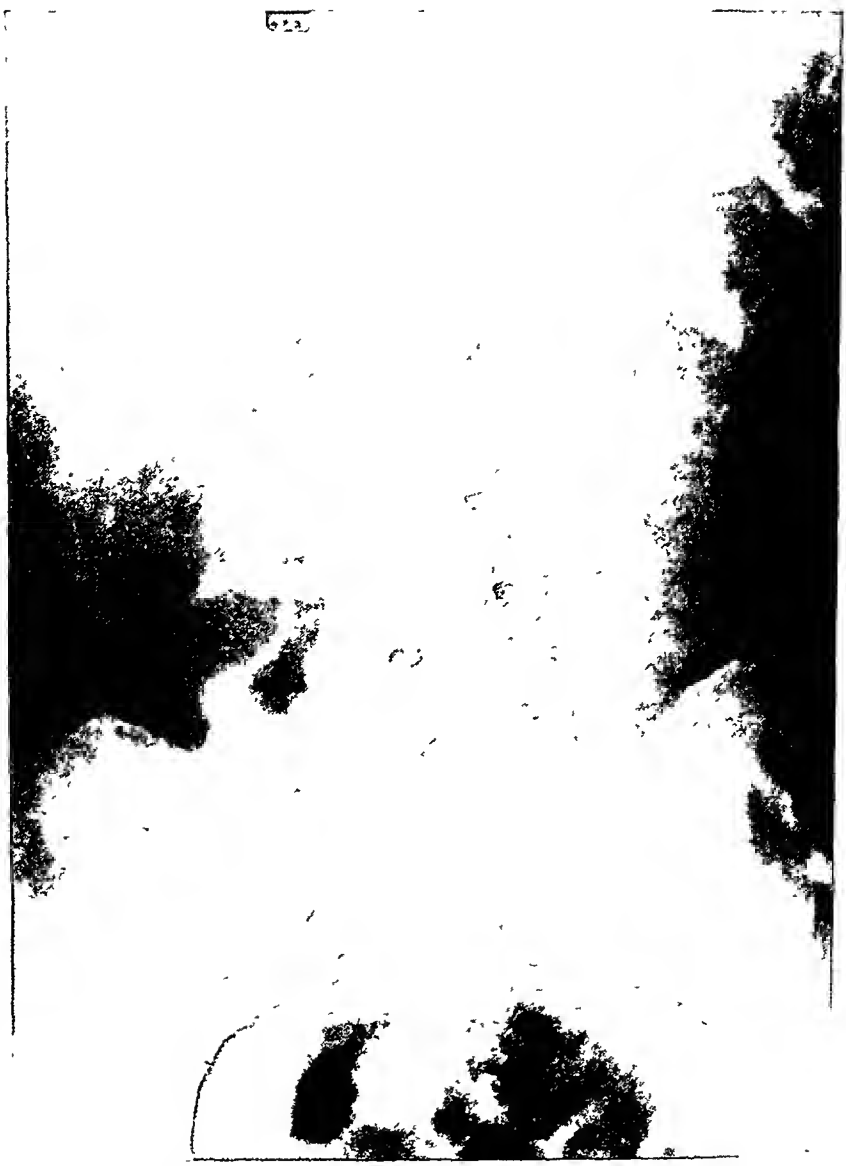

Fig 48—Shows normal pyelogram soon after delivery, again demonstrating the recuperative power of the kidney.

Fig 49.—Retrograde pyelogram with marked obstruction at ureteropelvic juncture causing marked dilatation

Fig 50.—Shows position of kidney after operation with the ureter now in position to drain pelvis. Film was made soon after operation and there is still some dilatation

Fig 51—Female, 41 years old On account of a few pus cells intravenous urography was done It demonstrated an enormous hydronephrosis with cortical necrosis on the right side Hydronephrosis was largely due to an aberrant vessel Nephrectomy was done

Fig. 52—Intravenous urogram showing carcinoma of the bladder

Fig 53.—Girl 17 years old Cause of obstruction in lower left ureter a pelvic abscess Attempted retrograde proved impossible Rapid recovery following pelvic drainage

Fig 58.—Patient had pain in lumbar area Intravenous urogram showed apparently normal pyelograms

kidney. Too much emphasis cannot be placed upon the individualization and the complete examination in each case. As an example of this, Fig 58 the patient was sent in for x-ray examination of the lumbar spine because of pain in this area. Dense shadows were reported in the right ureteral area and intravenous urography was ordered. Films demonstrated the shadows to be well away from the ureter, and what appeared to be normal pyelograms. An upright film was not made. The patient was then referred to a urologist, who suspected a ptosed kidney. Fig 59 shows a marked ptosis which could account for her symptoms.

Fig 60 shows a ruptured kidney in a young boy following an accident. Note the dye along the path of the ureter.

Fig 59 —Upright film taken later by retrograde method shows ptosed kidney

In Fig 61 transitional cell carcinoma had completely replaced the kidney tissue, hence no pelvis can be seen on the right side.

Fig 62 shows calyceal diverticulum out from upper calyx on right side. This was proved at operation. Gallstones can also be seen.

Fig 63 shows an accessory ureter with an ectopic orifice in the labia.

The following cases demonstrate bladder findings by flat films and cystograms. Fig 64 shows a bladder filled with Skiodan through the urethra and in

(Text continued on page [illegible])

Fig 58 —Patient had pain in lumbar area Intravenous urogram showed apparently normal pyelograms

Fig 61 —No pelvis could be demonstrated on the right side Transitional cell carcinoma arising from the pelvis had completely replaced the kidney tissue

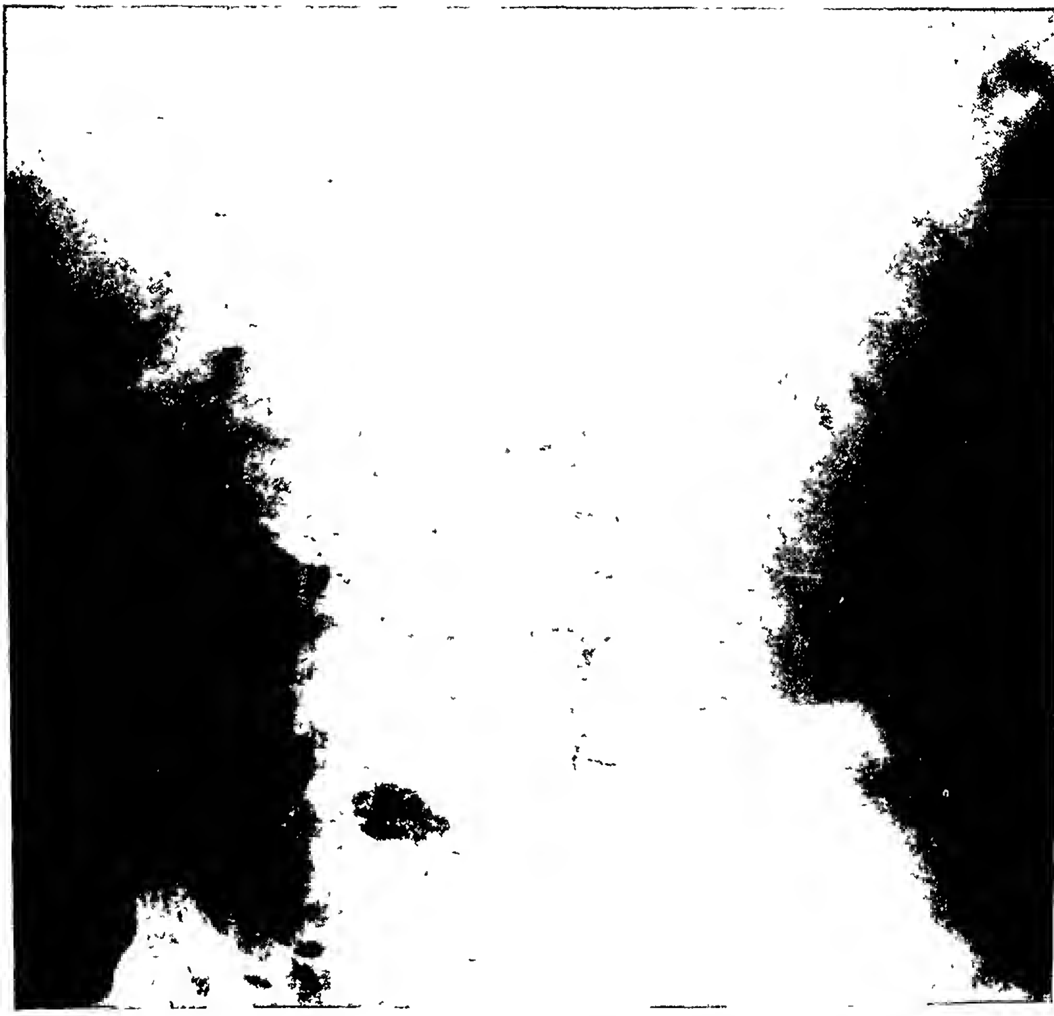

Fig 60 —Intravenous urogram showing the dye along the path of left ureter At operation he had a rupture in mid-third of kidney

Fig 63—Girl 17 years old Incontinence all her life Following repeated prolonged and minute inspection a small opening was found in the mucosa of the vestibule This would not admit a catheter but by pressure against this area the ureter was filled

Fig 62.—Calyceine diverticulum out from upper calyx on right side This was proved at operation Gallstones can also be seen

Fig 63—Girl 17 years old Incontinence all her life Following repeated prolonged and minute inspection a small opening was found in the mucosa of the vestibule This would not admit a catheter but by pressure against this area the ureter was filled

Fig 64 —Normal cystogram

Fig 65 —Bladder displaced upward and to right side

Fig 66 —Stone in bladder

Fig 67 —Stones in prostate gland

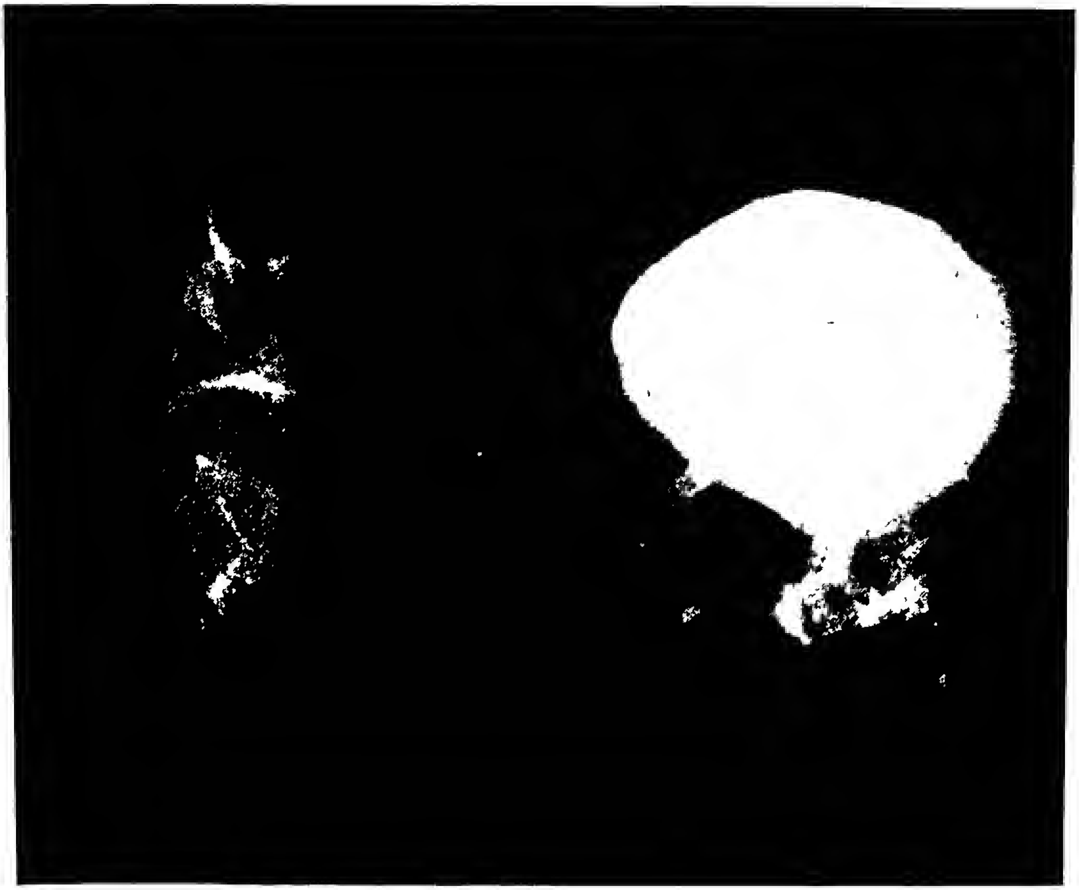

Fig 68 —Cystogram showing an enlarged prostate

Fig 69 —Air cystogram showing an enlarged prostate

normal relation with the symphysis Fig 65 shows a bladder markedly displaced upward and toward the right At operation, large infected cysts were found in the perineum and perivesical space Fig 66 shows a large bladder stone Fig 67 shows the more or less typical appearance of prostatic calculi As will be noted they are in the mid line and behind the symphysis

Fig 70—Cystogram with diverticula

Fig 68 shows the bladder filled with Skiodan, but lying well above the symphysis and showing an area of lessened density in its floor, which is characteristic of the deformity due to enlarged prostate gland Fig 69 is an air cystogram on the same patient Here it can be seen that the enlarged prostate pushes the tip of the catheter forward The shadow of the prostate can be seen in the floor of the bladder, reaching the level of the second hole in the catheter

Fig 70 is a cystogram showing two large diverticula with pedicles Often a large diverticulum is found in a routine examination and unless it can be demonstrated that there is retention after the bladder has been emptied, it is

(Text continued on page 109)

Fig. 71.—Cystogram with bilateral regurgitation

Fig 72—Cystogram in a paraplegic showing the more or less typical regurgitation frequently seen in such cases

Fig 73 —Normal cystourethrogram

Fig 74 —Cystourethrogram showing a large median lobe of the prostate.

Fig 75—Cystourethrogram showing a large benign hyperplasia with a broad posterior urethra suggesting pressure from lateral lobes

Fig 76—Congenital valves were found at operation

Fig. 77.—Cystourethrogram following perineal prostatectomy.

Fig. 78.—A very large prostate gland.

doubtful that any symptoms can be attributed to such a finding. Fig. 71 was a cystogram in a suspected case of carcinoma of the bladder; it shows how, at times, infection can travel from the bladder to the kidneys. Here it can be seen that when the bladder was filled there was regurgitation up both ureters, filling the kidneys on both sides. Fig. 72 is a cystogram with regurgitation in a paraplegic, Fig. 73 a normal cystourethrogram. Fig. 74 is a cystourethrogram showing a large median lobe while Fig. 75 shows a gross defect with broad posterior urethra. In Fig. 76 congenital valves are seen on a cystourethrogram. Fig. 77 is a cystourethrogram following perineal prostectomy.

Fig. 78 is a cystourethrogram showing a very large prostate gland.

Fig. 79 is a cystourethrogram in a carcinoma of the prostate.

Fig. 79.—Cystourethrogram showing a carcinoma in the prostate. The posterior urethra is very straight.

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CHAPTER III

PREOPERATIVE AND POSTOPERATIVE CARE OF THE UROLOGICAL PATIENT

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PREOPERATIVE TREATMENT

Assuming that the history and physical examination and necessary laboratory studies have been performed, many urological patients require somewhat prolonged treatment before they are in the best possible condition for operation. Most urological surgical conditions lead to impairment of renal function which if severe enough invariably leads to acidosis, malnutrition, or anemia. In addition because of the age group of many of these patients there will be cardiovascular complications and also other systemic diseases, especially diabetes. Insufficient intake of vitamins over a long period of time is astonishingly frequent Because of these complicating factors it is especially desirable in urology that the patient as a whole be considered and not just one small segment of his anatomy. The preoperative studies will usually reveal whatever complications may be present and it is advisable to attack these in an orderly manner.

Anemia.—Patients with mild anemia who do not need immediate operation should be placed on a suitable diet with a high vitamin content and given iron and liver extract If delay is not advisable whole blood transfusions may be used, one before operation and, if necessary, one during the operation If only one transfusion is necessary it is advisable to use this during the operative procedure A secondary anemia of long duration which involves no plasma loss may be combatted by the use of a suspension of red cells A large number of red cells with a corresponding rise in hemoglobin may be given in this way with less risk of overloading the circulation

Infection.—Infection adds greatly to the hazard of surgical procedures and, when time will permit, it should be reduced to a minimum before operation is done. The administration of antibiotics, of sulfa derivatives, or of Furadantin is indicated but should be withheld until adequate drainage is restored. If the kidney is involved, drainage should be obtained by a ureteral catheter and if the bladder, a urethral catheter Cultures should be made to ascertain which is the offending organism and in vitro studies made as to its sensitivity to various drugs During this period of time, however, even before the results of the culture have been reported, provided drainage has been established, antibiotics should be given and usually one of the wide-range

gram negative inhibitors will be of value Tetracycline is at present the most popular drug in our hands If the urinary tract is not infected when the patient is first seen the strictest asepsis in handling instruments and catheters should be practiced Careless catheterization may destroy weeks of painstaking work If intelligent effort is directed at decreasing or preventing preoperative infection, there will be a gratifying reduction in postoperative complications

Malnutrition—Poorly nourished patients are always poor risks for surgical treatment In some cases chronic sepsis or a chronic uremic state which interferes with digestion is responsible for the condition There is always an associated anemia Blood transfusions administration of dextrose solution intravenously, and vitamins by hypodermic injection are usually very helpful in such patients Dehydration is often associated with malnutrition or may be found in patients with frequent and painful urination or bladder obstruction, who have abstained from drinking because of discomfort in voiding This condition is readily corrected by the administration of fluids either by mouth or parenterally A dry tongue suggests prompt action

Impaired Renal Function—Most patients who present themselves requiring some type of urological surgical procedure will have impairment of renal function Usually it is a problem of drainage to get the kidneys into the best shape possible before operation Most surgical lesions of the upper urinary tract will involve only one kidney and, with the contralateral kidney functioning improvement of the involved kidney is best obtained by going ahead with the surgical procedure In the occasional case of bilateral tuberculosis or bilateral ureteropelvic junction obstruction, drainage of one kidney may be advisable before attempting the definitive repair or removal of the opposite kidney These cases are the exception, however rather than the rule When the obstruction is at the bladder neck then usually there is bilateral renal impairment which will improve with drainage This improvement should be anticipated and should be awaited before the surgical procedure is carried out The improvement in some cases may be quite rapid, in others it seems interminable Certain cases will require drainage for months before they reach what is probably their highest obtainable level of renal function When this level is reached despite a low total function, if the patient has been up and about and seems alert and especially if his appetite is good, one can usually go ahead safely with the procedure contemplated If drainage is necessary over a long period of time it is probable that a suprapubic cystostomy should be done In this way much of the infection which is prone to involve the lower urinary tract with an indwelling catheter may be avoided and the catheter is much better tolerated Not infrequently an added bonus from this procedure will be a marked reduction in the size of the prostate, suggesting that a transurethral procedure may be the operation of choice rather than an open operation

If the impairment in function is prerenal in origin it becomes necessary to treat the underlying condition Cardiac failure is probably the commonest

and this is best left in the hands of those most competent to handle it. Almost invariably with diabetes there will be some loss of kidney function. Chronic nephritis and cardiovascular renal disease present problems which require the finest judgment in deciding when to operate and whether or not the risk of operating is justified. Suffice it to say, in this group of conditions, it is wise for the urologist to surround himself with competent advisors and associates. The problem usually resolves itself into whether or not the patient can withstand the anesthetic. It has been our experience that most of the so-called poor-risk patients withstand anesthesia quite well, and all urologists can recall patients on whom operation was begun with fear and trembling who went through the procedure well, who had postoperative hemorrhage, and who had to be taken back to the operating room and withstood a second procedure equally well. While caution should be the watchword, one should not deny the patient years of comfort because of a little risk.

Nursing Care.—It is hard to place too much emphasis on nursing care. The manner in which the patient is received into the hospital and the effort to get the patient properly adjusted and to make him comfortable makes a decided impression and often influences to some extent the result of the treatment. Kindliness is possibly the foremost attribute for a nurse. The ability to answer silly questions, to respond to various whims and quirks in temperament, and to allay fear is necessary and directly proportional to the interest in and the desire to be helpful to the patient which the nurse possesses. Nursing procedures, such as routine bed and skin care and the care of the various tubes which may be attached to one or another portion of the patient's anatomy, are of the utmost importance. Alertness to sudden changes in the patient's condition and the prompt notification of the physician responsible may mean the difference in certain instances between life and death for the patient.

Good orderly care is equally important. An enema can be a blessed relief or a frightful experience, depending on the individual carrying out the procedure. More breeches of aseptic technique are committed by orderlies than by any other individuals responsible for the patient's care. All too often this portion of medical practice is left in the hands of those either careless or incompetent and the patient's stay in the hospital made many times more unpleasant than is necessary.

Preoperative Medications.—In general, preoperative medication should be limited to a mild hypnotic to allow the patient to sleep. In our hands the administration of ½ grain of codeine, ½ grain of phenobarbital, and 5 grains of aspirin at bedtime gives relief from the various distresses incident to being in the hospital and allows a night's sleep without a hangover. Stronger barbiturates are contraindicated in the elderly patient unless there is a history of having taken barbiturates over a period of many years. In many elderly patients barbiturates produce a state of stupor with fogging of the consciousness but, instead of sleep, an extreme restlessness and it is these patients who, troubled by hallucinations or dreams, may fall out of bed or do themselves damage in other ways. Other special drugs may be required as the patient's

condition indicates vitamins have already been mentioned and chemotherapy or antibiotics may be ordered *If the ureters are to be transplanted it is* advisable to start chemotherapy early in order to try to change the flora of

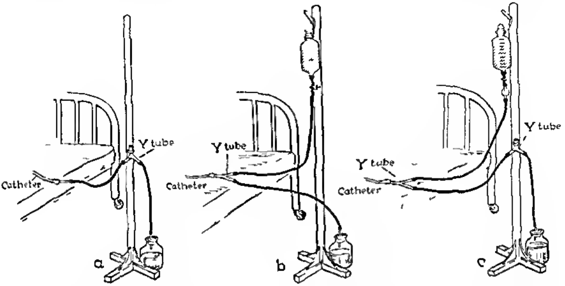

Fig 80 —Variations of the Y tube—1 *a* Y tube taped *to bedside stand To place at* the proper height first raise the tube until the glass is empty then lower it until the urine just begins to run over the hump Tape at this level *b* Closed irrigation system To irrigate open clamp and close outflow tube then clamp intake and open outflow *c* Continuous irrigation system Fluid drips steadily from container and enters bladder When bladder is full it contracts and forces contents over hump of Y tube (Carney J F Lindsay Q and McCrea L E U S Armed Forces Med Jour Oct 1951 15:5 1577)

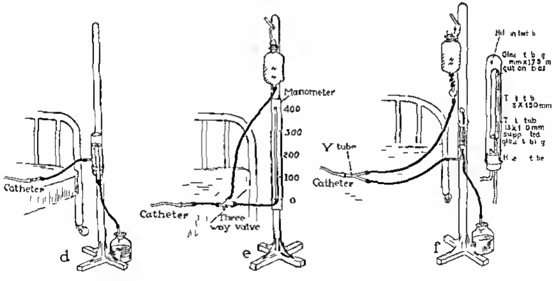

Fig 81 —Variations of the Y tube—2 *d* Simple decompressor Urine flows into large tube and rises to level of central tubing through which it empties into container May be used as bladder splint *e* Bladder pressure apparatus Saline is allowed to run into the bladder in 50 c c increments The changes in bladder tension are read on the manometer after each 50 c c *f* Tidal irrigation apparatus Consists of two test tubes and a length of glass tubing (Carney J F Lindsay Q and McCrea L E U S Armed Forces Med Jour Oct 1951 15:5 1577)

the large intestines Immediately preoperatively it is customary to administer an adequate dose of morphine or one of its derivatives depending on the body weight of the patient, and $\frac{1}{150}$ of atropine or scopolamine, depending here

usually on the preference of the anesthetist. If the patient is to have a spinal anesthetic and is under 50 years of age, ¾ grain of ephedrine may be given in order to maintain the blood pressure during the anesthesia period

Care of Catheters.—During the preoperative phase of a prostatic operation, when drainage is needed, an inlying catheter is the best method of obtaining it. The catheter of choice is the 5 c.c. balloon catheter. This does away with attaching the catheter to the penis by adhesive tape or other methods and allows free drainage of the urethral secretions and is usually well placed since the balloon eventually is pulled down against the prostate by the weight of the attached tubing. If for some reason a balloon catheter cannot be passed, then the catheter of choice is a two-eyed Robinson catheter, which should be carefully taped in place. To place the catheter properly it should be passed to a point where the urine is flowing freely through it, and it should then be withdrawn until the flow ceases and reintroduced into the bladder approximately one inch and then taped at this level. A catheter which is too far in does not drain well and in addition will produce bladder spasm by lodging against the wall of the bladder. Bladder spasm may also occur with the balloon catheter and is best combatted by attaching the patient's catheter to a Y tube, the top of which is placed a little above the level of the mattress. This maintains a little urine in the bladder most of the time, which serves as a buffer around the catheter

Strictest asepsis should be used in the passing of the catheter and after it is passed it should be connected to sterile tubing. When the patient is allowed to get up, and most of these patients should be up if it is at all possible, care should be exercised in the connection and disconnection of the tubing In the usual clean case the catheter should be inserted and left alone. Irrigation is not advisable unless there are clots or unless the urine is particularly foul. Irrigation should be done only with a definite purpose in mind and not as a routine procedure.

POSTOPERATIVE CARE

In the immediate postoperative care of a patient minor details, such as position of the patient and the proper hypnotics, assume greater importance than in the later phases Nursing care and close observation are of the utmost importance.

It is our custom to write orders in the immediate postoperative phase for the following procedures

1 **Diet.**—In major surgical procedures with a general anesthestic we feel that it is advisable that the patient be placed on nothing by mouth for the immediate postoperative period For lesser procedures, such as transurethral resection with spinal anesthesia, the patient may be given liquids and a soft diet for the following meal if the liquids are tolerated well.

2 We usually request that the blood pressure, pulse, and respiration be checked every half hour until stable We like to be notified if the blood pres-

sure falls below 100 In this way a close check is automatically kept on the patient in the immediate postoperative period and any grave change will be noted and the house staff or attending physician notified promptly

3 We are specific in writing orders with regard to the care of the patient's postoperative catheter, whether a nephrostomy or some form of bladder drainage It is our custom either to supervise the attachment of the catheter to the proper drainage tubing or to check it within a short time after it has been attached

4 **Antibiotics**—We feel that the prophylactic use of antibiotics is to be recommended for any patient who is wearing an indwelling tube of any kind The presence of infection plus a tube in the body may be so disastrous that we feel that antibiotics should be given despite the possibility of sensitization of the patient to one of the drugs used In urological surgery, since the commonest offenders are gram negative rods, we feel it to be especially necessary to cover this portion of the bacterial spectrum

5 **Position**—The position of the patient immediately postoperative depends on the type of operation which was performed For instance, after a nephropexy the foot of the bed should be elevated in order to maintain the position of the kidney without drag on the sutures Also a nephrectomy wound will probably drain better in the immediate postoperative period if the patient is placed on the involved side With certain of the spinal anesthetics it is important that the patient's head be elevated, and with others the foot should be elevated or the bed should be kept flat In whatever position the patient is placed it is important that he not keep still for long periods Even with the foot of the bed elevated and the patient placed on the involved side one can still let the patient rotate to the back and then back again to the involved side

6 **Narcotics**—With regard to narcotics it is our belief that the less of this type of drug which can be administered without undue distress to the patient the greater the benefit to the patient in the long run For the relief of pain there is no substitute for adequate doses of morphine or its derivatives or Demerol but certainly this can be overdone The dose depends on the body weight age, and sensitivity of the patient to the drug Enough should be given to relieve pain but not so much that respiration is slowed We usually give morphine sulfate up to ¼ grain every four hours for the first twenty four hours and reduce it on the day following Usually by the second postoperative day ⅙ grain of morphine every four hours will suffice to keep the patient comfortable If more than this is needed the wound should be investigated the catheter should be irrigated, or some other source of irritation should be searched for and, if found, relieved This is especially true of patients who have undergone prostatic surgery who should exhibit little or no postoperative distress if all tubes are draining well and if their wounds are not infected We begin by having the patient sit on the side of the bed as soon as we feel that it is feasible and this is usually during the first post

operative day. By the second day he can usually sit in a chair or maybe even take a few steps. This early ambulation, while it may not achieve its original purpose of reducing the incidence of emboli, has, however, certainly shortened the hospital stay of the average patient and the intestinal tone and general sense of well-being improve much more rapidly in these patients than in those who remain quietly in bed.

7. **Fluids.**—The problem of proper parenteral fluid administration becomes more difficult as further knowledge is added to our understanding of the protein-electrolyte-water complex of the body. In the great majority of surgical cases, however, there is no need for overcomplication of thinking. Parenteral fluids are given to combat shock or to supply food, water, vitamins, and inorganic salts in the proper balance The choice of the right fluid at the right time depends on the purpose for which it is used, on clinical experience, and on laboratory studies

The choice of fluids to combat shock will be discussed under the subhead "Shock." If the patient is on "nothing by mouth," all of the substances necessary to sustain life must be supplied parenterally. First of the body requirements and actually the easiest to supply is water. The usual daily requirement of the body is 2,500 c.c. of water as such. When given intravenously as 5% dextrose in water, this is available to the body as soon as the dextrose is metabolized. It should be remembered that when normal saline or Ringer's solution is given intravenously no water is available to the body until the contained salts are either excreted and the water retained by a functioning kidney or metabolized to form other compounds within the body which will allow the freeing of a little water Patients who are running a fever or who were dehydrated previous to operation or who have a very large body surface may require a considerably larger amount of water than 2,500 c c The required amount can usually be estimated by the appearance of the patient, the turgor of the skin, the dryness of the tongue, and the body weight of the patient. A patient who is receiving all of his nourishment parenterally and is gaining weight is becoming edematous whether the edema is clinically apparent or not It should be remembered that the edema is not confined to the subcutaneous tissue but that also the bowel will become edematous, and the kidney, and the brain, and the function of all the various body systems will be impaired and their recovery delayed This is almost invariably associated with excessive administrations of sodium chloride; a normal blood chloride does not mean that there is not an excess of chloride in the body, since the tissue spaces may be overfilled and the blood level normal. For the most accurate follow-up, the patient should be weighed daily, but most of these patients are confined to bed and only a very few institutions are equipped to weigh the patient and the bed simultaneously, so that in most instances weight gain has to be estimated

There are two major contraindications to the administration of intravenous dextrose in water; one is cardiac failure and the other is lower nephron nephrosis. It is a rare patient indeed in whom cardiac failure is precipitated by the administration of dextrose in water but it can be done and reasonable caution

should be exercised when the patient has severe cardiac damage. During the retention phase of lower nephron nephrosis water should be limited. It is quite easy to overload the patient because of the limited excretion of fluid of any kind.

In order to supply food to the body it is not usually feasible to attempt to replace the entire daily caloric necessity. Usually the period during which parenteral fluids are necessary will be of short duration and the patient can metabolize his own fat and proteins and a portion of his caloric requirements be replaced or be furnished by intravenous dextrose. In the resting state the average individual requires about 1,500 calories per day. Each gram of dextrose furnishes 4 calories, 3,000 c.c. of 5% dextrose will furnish 600 calories. Little is gained by the administration of 10% dextrose in water, since much of the dextrose given is spilled over into the urine, and nothing is gained by the administration of 15% dextrose, since this merely dehydrates the patient and the greater portion of the dextrose is lost in the urine.

Vitamins B and C have been manufactured in such pure form that they can be used intravenously. They are used in any case in which parenteral drainage over a period of time is obviously going to be necessary. We have seen no dramatic improvement from their use but believe that they are helpful.

The administration of inorganic salts has been a subject of controversy and individual predilection since it was found that it was possible to give these substances intravenously. Calcium, sodium, potassium, and magnesium, chlorides, carbonates, gluconates, lactates, etc., are available for intravenous use. The right proportion of these substances for each individual patient can be determined only by laboratory studies made on the morning of the day in which one contemplates giving the substance. The laboratory studies which are useful are sodium and potassium milliequivalents, CO_2 milliequivalents, chloride milliequivalents found in the blood serum and Fantus' test for urinary chlorides content. The urea nitrogen is also helpful in determining the patient's course from day to day. The EKG is characteristic if the serum potassium is too low. It is our custom with those patients who are restricted to nothing by mouth to give 5% dextrose in water in the morning and then, when the laboratory work has been reported, to give the amount of the inorganic salt indicated by the laboratory reports. We give these substances just as we would give any other indicated drug, for instance, if the chloride milliequivalents are low we give normal saline. If the potassium is low, potassium is given. If the CO_2 combining power is depressed, then sodium lactate is administered.

It is impossible to lay down any hard and fast rules which will cover all cases. Each case must be individualized and must be followed closely. We believe that the use of 5% dextrose in water is the basic food and drink solution and the administration of the various electrolytes, especially sodium and chloride, only as indicated by the laboratory studies will usually give one the best chance of maintaining the patient in balance.

With these orders we usually manage to get the patient through the immediate postoperative period. On the first postoperative day the dressing should be changed in most urological cases, since they are usually drainage cases and a sticky dressing is an added, unnecessary discomfort If it is a clean case, the drains in the renal fossa should be loosened and should be shortened daily thereafter. If the patient is feeling well enough or if the operative procedure was not too shocking or prolonged it is possible that the patient may be given food by mouth on this first day. Usually it is best to start with sips of water and follow with some clear liquid, such as tea, or with dry toast, rather than full liquids. Orange juice can be irritating and cause bloating, and milk is even worse in this respect. With a little distention and a listless patient it is better to give intravenous fluids than to attempt to force food or water by mouth at this time. In the patient who has been through a really large kidney or adrenal operation it is usually best to wait until peristaltic sounds can be heard before beginning anything by mouth. For the mild discomfort of gas pains, which may be seen occasionally on the first postoperative day, a rectal tube is quite helpful. The use of Prostigmin when indicated may be of value, but it is frequently used when entirely unnecessary This drug enjoys a considerable vogue among the house staffs in our hospitals and is a source of expense in the ever-mounting cost of medical care. Its routine use is certainly not indicated I have not personally ordered an injection in five years and have not been able to see that withholding it made any great difference in the postoperative course.

POSTOPERATIVE COMPLICATIONS

Complications.—The postoperative course of all urological patients is not necessarily what one would desire. As in any surgical procedure, unexpected complications appear and these are made more intricate by the presence of catheters and tubes of all kinds. Certain of these complications warrant individual discussion

Infection.—Adequate drainage is the most important factor in the control of infection Stagnant urine is an excellent culture medium and when permitted to accumulate either in the cavities of the urinary tract or in the cellular tissues surrounding them serious harm may be expected. Operation upon the infected urinary tract should include liberal drainage of the organ operated upon, if it is not removed, and of the surrounding cellular tissues In all cases at least a rubber tissue drain should be left in the depths of the wound for a few days. Tubes draining the kidney or bladder should lead to the surface in a straight course so that they may be easily replaced if necessary Tubes should be securely fastened to the wound and to the dressing and should be frequently examined during convalescence to see that they are kept in place. The tube draining urine should be attached to a sterile tube and bottle which should be cleansed and resterilized at prescribed intervals. Irrigations should be done by gravity, particularly when irrigating the kidney. The forcible injection of fluid into an infected renal pelvis may cause an extension of infection.

The most satisfactory drainage material for the wound is the cigarette drain made by drawing a strip of gauze through a length of rubber tissue tubing. This should remain in place from two to four days, depending upon the extent of infection. If there is considerable purulent drainage when the cigarette drain is removed, a soft rubber tube should be placed in the drainage tract. The tube should extend to within about an inch of the bottom of the tract and should be withdrawn and shortened every few days as the wound heals from the bottom. Actively infected wounds should be irrigated through the tube by gravity. Normal saline is the most universally useful solution; mild antiseptics may be used. When the drainage contains alkaline urine or when there is pyocyaneus infection, a 1:500 solution of acetic acid is indicated. When there is drainage of urine into the wound, continuous aspiration is very helpful. Dry heat from an infrared lamp is useful in the treatment of infected wounds; it lessens pain and soreness and seems to hasten the healing process.

Careful hemostasis is also an important precaution against wound infection. When a hematoma forms or blood clots accumulate in the wound, healing is retarded and infection encouraged. Whenever bleeding cannot be completely controlled by ligature or suture, the area should be packed and adequate drainage provided.

The practice of applying antiseptics directly to the wound has been largely discarded. If it is desirable to flush out a wound at operation, normal saline is the solution of choice.

Following operation, the prophylactic administration of penicillin and streptomycin singly or in combination deserves consideration. It is not our custom to administer either following the majority of urological procedures, but in contaminated cases they are indicated and may be lifesaving. It should be emphasized that the antibiotics are no substitute for careful attention to the wound and the provision for and maintenance of adequate drainage.

Hemorrhage.—Excessive bleeding during the convalescent period usually occurs within a few hours following operation or after a lapse of several days. Early bleeding may be caused by a slipped ligature, a blood vessel temporarily occluded and overlooked, or by an increase in blood pressure. Bleeding from a slipped ligature is usually profuse and requires immediate attention. The wound should be rapidly opened and securely packed with gauze until provision can be made to secure and ligate the blood vessel. Blood loss should be replaced by transfusion. If this is not immediately available the blood pressure is sustained by the intravenous administration of dextrose solution or blood plasma. Secondary bleeding from blood vessels that have been temporarily occluded by crushing or twisting is rarely so profuse as that from a slipped ligature because the vessel is usually not so large. Such bleeding may, however, be quite troublesome and if it cannot be controlled by a light pack the wound should be opened and the vessel ligated. Patients who leave the operating room in shock or with a low blood pressure because of spinal anesthesia may be expected to bleed when the blood pressure reaches its normal level. Such bleeding is rarely serious but is occasionally quite trouble

some, especially following prostatectomy, where packing or coagulation is usually depended upon to control the bleeding. This type of secondary bleeding can usually be prevented by maintaining the blood pressure at a normal level during operation by the use of dextrose solution intravenously. When blood clots have accumulated in the bladder, bleeding often continues until they are removed. Following transurethral operations continuous irrigation should be used or a decompression apparatus should be so adjusted that a few ounces of solution will remain in the bladder until bleeding is no longer sufficient to occlude the catheter with clots.

Delayed secondary bleeding is usually caused by infection. It occurs most frequently following nephrostomy and transurethral resection of the prostate, but may occur in any infected wound

Secondary bleeding from an infected kidney is a serious complication The bleeding may be controlled by packing or may stop spontaneously but almost always recurs. If the initial hemorrhage is not severe, the nephrostomy tube if present should be removed and the patient be kept quiet with morphine. If there is a large drainage tract, it should be lightly packed with gauze. The packing is changed daily and urinary antiseptics are given by mouth or parenterally.

If bleeding is profuse or if it recurs, nephrectomy is the safest treatment When it is important that the kidney be saved, a more conservative operation may be tried. In a case of severe secondary bleeding with a stone in the opposite kidney the nephrostomy wound was packed with perirenal fat which was held in place with a mattress suture through the kidney. No further bleeding occurred and the patient recovered with good renal function

Delayed bleeding from the prostatic cavity is usually controlled by aspirating clots and replacing the catheter for a few days. If the bleeding is of real consequence, it is best controlled by the evacuation of clots by means of the Ellik evaculator through the fiber sheath of the resectoscope. Spinal anesthesia is usually used After the field is clear, the prostatic bed should be inspected and the bleeding points coagulated under vision. If this proves impossible because of venous sinus bleeding or generalized oozing, a 75 to 100 c.c. balloon catheter may be passed, the balloon distended with fluid and tension placed on the catheter to maintain pressure against the bleeding area Rarely, it is necessary to pack the prostatic bed with gauze. If this must be done, the bladder should be opened suprapubically—unless a suprapubic prostatectomy had previously been performed—and the prostatic bed sponged dry. A layer of oxidized cellulose may then be placed against the oozing area and dry gauze packed against this.

Shock.—Severe shock following urological operations should be rare Patients who are in poor condition or who must undergo a long, tedious operation should be given whole blood to sustain the blood pressure during the operation. The amount given depends on the extent and duration of the procedure. It is extremely important to keep the patient's blood pressure at a safe level. A systolic blood pressure below 80 for even an hour may cause

anoxemia Anoxemia alone may produce a shocklike state so that a vicious cycle is set up and unless it is interrupted, death will supervene It is our belief that every possible effort should be made to interrupt this cycle and that, in order to maintain an adequate systolic blood pressure whole blood should be given even to the point of possible overloading of the circulation If blood given in the usual manner seems ineffectual, arterial transfusions may be considered After the operation is completed, if one feels that he has already given as much blood as is safe then a solution of 5% dextrose in which 4 c c of norepinephrine is dissolved in 1,000 c c of dextrose given intravenously may help to maintain the blood pressure When given slowly this has proved to be of considerable value The patient should be kept warm and dry The foot of the bed should be elevated Oxygen by nasal catheter is indicated A Levin tube may be lifesaving It is astonishing how often these patients will have dilated stomachs

Abdominal Distention—Attention to the elimination of the bowels is important Very few patients have normal evacuation when in bed and failure to maintain good elimination before operation probably accounts to some extent for postoperative distention If there is evidence of gas in the stomach if the patient is constantly nauseated but unable to vomit, or if he vomits dark malodorous material immediate gastric lavage should be done The tube is then left in place until the return flow has the appearance of normal gastric fluid When there is persistent nausea and vomiting, the patient's fluid balance must be maintained by the administration of parenteral fluids

After evidence of peristaltic activity has appeared, enemas may be given once or twice a day The 1 2, 3 enema composed of one ounce of magnesium sulfate two ounces of glycerine, and three ounces of mineral oil is very satisfactory for this purpose Enemas should be used with extreme caution, if at all following suprapubic or perineal prostatectomy because of a possible increase in the risk of pulmonary embolus Mineral oil or a combination of oil and agar should be given daily at bedtime as soon as the patient can retain it Mild laxatives should be given when necessary as soon as the patient can take solid food

Occasionally severe infection of the kidney or suppuration in the retroperitoneal space is accompanied by adynamic ileus with severe distention nausea and vomiting Efforts to stimulate peristalsis meet with very little success A Levin tube should be passed and drainage established by the method of Wangensteen Enemas will not be expelled, but some relief may be obtained by attaching an irrigating can containing a warm solution of bicarbonate of soda to a rectal tube, and then raising this can a few inches above bed level until a portion of the solution has run in and then lowering the can to floor level and allowing the solution to drain off This process is repeated throughout the day and is usually quite helpful

Hiccough—Hiccough is a frequent complication of urological operations, especially operations upon the prostate In most cases it is of short duration

and causes very little trouble. Occasionally it persists and is very exhausting to an enfeebled patient. Numerous causes of hiccough have been mentioned. In urological patients it is most frequently caused by delayed emptying of the stomach or by poor renal function. It is at times the first evidence of uremia Many remedies are advised, none of which is always dependable A stomach tube should be passed, to determine the character and amount of retained material and to irrigate the stomach with cold normal saline solution. This will often give relief for a considerable period, and if foul material is retained in the stomach, the procedure should be repeated every four to six hours or a Levin or Jutte tube should be left in place for continuous drainage. The inhalation of carbon dioxide will control hiccough to some extent It may be given by a carbon dioxide oxygen inhaler or by having the patient rebreathe his expired air in a paper bag Occasionally the paroxysms are controlled for several hours Sedatives may be necessary to induce sleep in severe cases When the patient can sleep hiccough is never severe and occasionally stops entirely. Benzedrine sulfate, 5 mg. repeated in four hours, will control hiccough in some cases It should not be given within four hours of bedtime. When all other treatment has failed some surgeons have blocked or crushed the phrenic nerves This is rarely necessary As the kidneys and intestinal tract begin to function normally the hiccough is usually cured.

Embolism.—Embolism is said to account for about 5 per cent of the deaths in urological patients It occurs most frequently following operation upon the prostate. Prophylactic measures are the most important feature of treatment Early ambulation is the keynote of this program. If this is impossible, the position of the patient should be changed frequently; if he is too weak to exercise himself, passive exercise and massage should be given. Ace bandages applied from foot to knee are recommended. Homans' sign should be elicited daily. Enemas should not be used following suprapubic or perineal prostatectomy if an evacuation can be obtained otherwise. If it is suspected, from the temperature, pulse, or local findings, that thrombophlebitis has occurred, ligation of the femoral veins should be considered. With pain and tenderness in the region of the femoral vein, although the danger of embolism is not so acute, vein ligation should still be considered and the leg should be immobilized and elevated

Paravertebral sympathetic block is helpful in the treatment of phlebitis and also of equal value in many cases of arterial embolism If an arterial embolus occurs in an extremity and distal pulsations are palpable, one-half grain of papaverine hydrochloride intravenously at frequent intervals will often relieve the reflex spasm of the collateral arteries, and adequate circulation may be maintained Papaverine hydrochloride in one-fourth grain tablets by mouth may be given for a considerable period of time The immediate care is most important The extremity should be kept horizontal or slightly elevated. Very gentle upward stroking of the extremity from its distal part to the area involved will in most instances relieve the congestion and cyanosis and maintain adequate warmth and circulation. Dicumarol or heparin offers the

best treatment for the prevention and for the limitation of extension of embolism. If the occlusion is complete, arterial embolectomy may be necessary and this operation must be performed within the first eight hours.

Pulmonary embolism is one of the most tragic of all complications of surgery. The patient is doing well, sitting up, moving around. There is a sudden onset of severe chest pain, breathlessness, pallor, syncope and death. Very rarely prompt surgical intervention may save such a patient. A number of patients recover even after several emboli proved both by physical signs and by x-ray examination. All too many of them, however, die. In prevention lies the only hope of avoiding these deaths. It has been our experience that the best warning signs of impending possible embolus are Homans' sign and a slight, unexplained irregular elevation of the temperature. We are particularly careful with the patient who tends to run a temperature around 99-100° F. in the afternoon and to be normal in the morning.

Atelectasis.—Atelectasis is not an unusual postoperative complication. The patient presents a sudden rise of temperature, with increase in respiration, a rapid pulse, and leukocytosis. Examination of the chest reveals decreased expansion on the affected side and diminished breath sounds. The sound made by breathing past tenacious mucus in the large bronchi or the trachea is quite characteristic and can be heard without the aid of a stethoscope as a rough, wet sound which gives the listener the impulse to cough or clear the throat. This sound with the absence of tactile fremitus on the involved side is all that is necessary to establish the diagnosis, although it may be confirmed by roentgenological examination. If the collapse is extensive, there are signs of shock and the heart is displaced to the affected side.

The treatment consists of removing the plug of mucus. The simplest method is to force the patient to cough. The patient is instructed to exhale as far as possible and then to give a little cough as if one were attempting to elicit the sound of rales. As the cough is given, pressure is made with the hands against the lower lateral margins of the rib cage. The plug is usually started by this maneuver; a paroxysm of coughing ensues, and the mucus is expelled. CO_2 inhalations are helpful in increasing the depth of breathing and in liquefying the secretions. Occasionally bronchoscopy may be necessary.

Tension Pneumothorax.—Inevitably, if enough renal surgery is performed the pleura will be incised. When this occurs, positive pressure anesthesia should be started promptly. If the original anesthetic was spinal or local, oxygen under positive pressure should be given. The pleura is closed tightly just at the height of inspiration and the incident is usually of little concern. Rarely, however, even after the skin wound is closed, air will continue to be aspirated into the pleural space and will be trapped because of a ball-valve action of the pleural incision. Pressure will gradually be built up within the pleural space, the lung will be collapsed and the heart and mediastinum shifted toward the opposite side. Death will ensue if this complication is not recognized within a reasonable time. The diagnosis is readily made by the history of pleural injury and the unexpected collapse of the patient. On

physical examination the patient is not infrequently pallid and sweating; respiration is rapid and labored, cyanosis is usually prominent; the pulse is rapid and may be feeble Percussion over the affected side gives a characteristic booming note. No further diagnostic procedure is necessary, but it will be noted that breath sounds and fremitus are absent and cardiac dullness is shifted toward the opposite side Roentgenological examinations are confirmatory. Treatment consists of aspirating the affected side Frequently one aspiration is all that is necessary, because the ball-valve action of the pleural tear has been destroyed by fibrin deposits Occasionally, it is necessary to leave the aspirating needle in situ and attach it to a tube, the distal end of which is under water at floor level. With each inspiration a little air is forced out of the tube and on expiration there is insufficient negative pressure to aspirate the water into the pleural cavity. The air is thus gradually removed from the cavity and, if the pleural tear has sealed over, no further air is aspirated and the lung re-expands

Pneumonia.—Pneumonia is one of the chief postoperative dangers in elderly and debilitated patients They are sensitive to draughts and are apt to develop hypostatic congestion because of incomplete aeration of the lungs. Deep anesthesia should be avoided, whenever possible, local anesthesia should be used. Narcotics should be used sparingly. The patient's position should be changed frequently; he should be propped up several times a day and encouraged to breathe deeply. When there is evidence of congestion at the base of the lungs, carbon dioxide inhalations should be given several times a day. When pneumonia develops, chemotherapy, antipneumococcic serum, and oxygen should be administered as indicated. Nursing care and general supportive measures are of great importance

Cardiac Failure.—Some evidence of circulatory damage is frequently recognized in elderly patients. Hypertension is often found associated with hypertrophy of the prostate, and irregularity of the pulse is not unusual. During the preoperative preparation an effort should be made to determine the extent of the damage to the heart. Preoperative digitalization is indicated in some cases The condition should be considered when selecting the anesthetic. When there is evidence of cardiac damage, it is important not to overload the heart with an excessive amount of fluid When there is evidence of cardiac failure following operation, treatment consists of sedatives, oxygen, and stimulation as indicated. If the elimination from the kidneys is poor, digitalization is reached much more quickly than usual and the arteriosclerotic patient's tolerance to digitalis is quite variable.

Lower Nephron Nephrosis.—This syndrome occurs in association with shock, pregnancy, transfusion reactions, sulfa-derivative poisoning, and conditions which cause the liberation of hemoglobin into the blood stream, such as damage to large muscle masses from electric shock, or crushing injury, or the lacking of red cells when a hypotonic solution gains entry to the blood stream. It is thought to be caused by swelling, occlusion and degeneration of the distal convoluted tubules with resulting failure of the excretory ability of

the kidney It is possible that these changes are caused by ischemia from constriction or occlusion of the efferent arterioles The syndrome is characterized by a diminishing urinary output and an increasing retention of urea nitrogen and creatinine Usually there is a fall in the plasma carbon dioxide combining power The patient who at first may seem to be enjoying a good postoperative course becomes listless, there is loss of appetite, and the abdomen becomes distended The listlessness gradually increases into coma and not infrequently death supervenes If the renal injury is not too severe, the pathological process is reversible, and occasionally on the eighth to twelfth day after onset there will be a perceptible increase in the urinary output followed by a large flow of urine of low specific gravity The patient will then usually recover

Treatment is aimed first at prevention One should eliminate as far as possible the diverse causes of this syndrome Shock should be combatted as early as actively and as rapidly as possible Transfusion reactions are usually accidents and with reasonable care should be entirely prevented The indiscriminate use of sulfa derivatives is to be deplored Whenever these drugs are ordered the patient should be seen at frequent intervals and the drug discontinued at the first toxic manifestation Little can be done about pregnancy In order to prevent the laking of blood from the introduction of a hypotonic solution into the blood stream, as may occur when a venous sinus is opened during transurethral resection, an isotonic irrigating solution, such as glucose or glycine, may be used A solution which ionizes to any great extent cannot be used because of the dissipation of the power of the current into the solution which acts as a negative pole It is not our custom to use either glucose or glycine solutions, but rather to discontinue the procedure when a large sinus is opened

When the syndrome has occurred and it is felt that the renal function will be impaired for several days, treatment is aimed at restoring normal function as rapidly as possible at maintaining a normal water and acid base balance, and at removing the urinary waste products by extrarenal means Alkalies by mouth or molar sodium lactate parenterally are usually indicated since hemoglobin products and acetylated sulfonamide compounds are more soluble in an alkaline medium Fluid balance must be maintained, but excessive fluids should not be given in the hope of producing diuresis Sodium chloride solutions, except for the replacement of lost chloride are contraindicated If anemia is present transfusions of suspended red cells are helpful

Urea in appreciable quantities may be dialyzed from the blood stream through the gastric mucosa, the small intestinal mucosa the peritoneum, or the exteriorized blood stream Continuous gastric lavage is carried out by passing a tube having two channels through the nose into the stomach A drip is started into one channel and a Wangensteen suction attached to the other Analysis of the gastric washings will reveal that as much as a gram of urea may be removed in twenty four hours in this way In order to obtain dialysis from the small intestine a three channel balloon tube is prepared by cutting a hole in the side of the tube about two feet above the distal end The tube is then passed into the

stomach and the balloon inflated. After it reaches the large intestine, the balloon is deflated and the tube taped at this level. A continuous drip is then started into the channel with the hole in the side of it and a suction is attached to the large bowel channel. The recommended solution is sodium sulfate 2 per cent (N. S. R. Maluf, J. Urol. 60: 307-315, August, 1949). Despite frequent occlusions of the aspirating tube and annoying diarrhea, this method will reduce the urea as much as 8 grams in five hours. Lavage of the peritoneum is performed by introducing a tube in to the left upper quadrant of the abdomen and a sump into the right lower quadrant. The peritoneum is perfused continuously through the upper tube with a solution of the following composition: Tyrode's solution, 18-20 liters; sodium sulfadiazine, 2.5 Gm.; heparin, 100 mg.; and penicillin sodium, 600,000 units.

Another method is to insert only the sump. The perfusing solution is then introduced at intervals and as often aspirated through the sump. The setup requires careful attention, and peritonitis is a constant hazard, but 35 grams of urea may be removed in twenty-four hours in this way.

Exteriorization of the blood stream has passed the experimental stage and blood may be removed, dialyzed, and replaced in a continuous process by any one of several machines. The use of the dialyzers is limited to severe but temporary renal lesions.

Since many believe that the entire syndrome is based on renal ischemia, efforts may be directed at the relief of any venospastic element by blocking the sympathetic innervation, either paravertebrally or by continuous spinal anesthesia. Results from either of these methods have been difficult to evaluate. Risk is minimal.

Renal decapsulation has had its advocates for the past several years. We still are uncertain as to its positive value. It is thought that following insult the kidney swells. The capsule acts as a restricting membrane and, as the swelling increases, pressure on the nephrons still capable of functioning becomes so great that function ceases. There have been many cases reported of recovery following decapsulation, the recovery being ushered in by diuresis within twenty-four hours of the procedure. As many failures can be found in the literature. There has been no series in which one kidney only was decapsulated and diuresis occurred from that side. The nearest approach (C. W. Vermeulen and C. R. Snead, J. Urol. 60: 216-220, August, 1948) is in a series of experimental animals whose kidneys had been injured by the injection of mercuric chloride. Decapsulation exerted no influence on the recovery rate of animals with this type of injury. If decapsulation is to be done, it should not be deferred until the patient is in extremis.

Uremia.—Uremia should be a rare complication of urological surgery. The condition of the kidneys is carefully evaluated prior to operation, and measures are instituted to improve and conserve the renal function from the time the patient enters the hospital. The amount of urine eliminated should be measured or carefully estimated the first few days following operation.

When the renal function is known to be poor, frequent estimations of the blood chemistry should be made and constant diuresis maintained by the liberal administration of fluids. Free elimination from the bowels is also important.

In the event of diminished urinary excretion and retention of blood urea, immediate efforts should be made to increase diuresis by forcing fluids—by mouth, by hypodermoclysis, or intravenously. Warm colonic irrigations are helpful in reducing distention and promoting intestinal elimination. Hot packs and diathermy to the renal areas are often helpful. Efforts should be made to promote sweating by applying heat to the body and by giving hot drinks. Hot packs are useful but exhausting to debilitated patients. Paravertebral block for splanchnic anesthesia is often helpful in promoting diuresis.

It is important to remember the possibility of acidosis. If the carbon dioxide combining power indicates even a mild degree of acidosis, it should be corrected promptly. Drugs are of doubtful value. Mild sedatives or small doses of morphine should be given to allay restlessness. Large doses of caffeine or aminophyllin are occasionally used with the hope of stimulating renal function.

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CHAPTER IV

ANESTHESIA IN UROLOGICAL SURGERY

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There are several factors which necessitate especially careful consideration in the choice of anesthesia for urological patients Many of these patients are elderly, in an age group in which cardiovascular disease is apt to exist. As high as a forty per cent incidence of arteriosclerosis, coronary artery disease, and disturbances of cardiac rhythm has been reported by Karp and others. When cardiovascular disease does exist, its form must be accurately determined and a careful estimation must be made of the degree of interference by the disease with cardiovascular reserve. Elderly individuals have impaired mechanisms for adjusting to changes in blood pressure, and this fact must be given careful consideration. Nutritional deficiencies, especially in conjunction with long-standing disease, may result in the condition of lowered blood volume referred to as "chronic shock," and in such instances the stress of anesthesia, operations, and blood loss is tolerated very poorly Impairment of pulmonary function, such as emphysema, occurs fairly frequently in elderly individuals, and the presence of such conditions may make the administration of certain anesthetics hazardous. Certain anesthetic drugs impair renal function, which may already be compromised in urological patients.

In dealing with urological patients, cooperation between the anesthetist and the surgeon is most desirable in planning the operation and in the conduct of the procedure. In poor-risk cases detailed information which the surgeon can furnish will greatly aid the anesthetist in selecting the anesthetic which will result in the least imbalance to the patient.

Introduction of an explosion hazard by the presence of electrical apparatus during many urological procedures limits the choice of anesthetic to a technique which does not employ an explosive agent.

PREMEDICATION

Every anesthetic, of whatever type, demands proper preoperative preparation for the patient. Preoperative sedation should be sufficient to allay apprehension This is especially important where local or spinal anesthesia is to be instituted, in which instances the patient should be drowsy on arriving in the operating room In addition to sedation, the barbiturates provide protection against reaction to local anesthetic drugs Morphine produces euphoria and provides analgesia Certain local anesthetic procedures are somewhat painful, so that analgesia should be provided The dose of morphine must be reduced in elderly patients in order to obviate respiratory depression, or small doses of Demerol may be substituted.

Atropine is used for the drying effect on troublesome secretions; in addition, its action of blocking parasympathetic nervous impulses may prevent undesirable reflexes in the larynx, bronchi, and the myocardium. Scopolamine

is preferred by some because of its sedative action, which is useful in many instances, but in the elderly, sedation is readily achieved without the inclusion of scopolamine and it sometimes causes disorientation in these individuals. As compared with atropine, the vagal blocking action of scopolamine is relatively weak, and this may constitute an objection to its use.

The time of administration of preanesthetic drugs is of great importance and is too commonly disregarded. An hour is required before adequate action of morphine occurs following hypodermic administration, and about the same length of time should be allowed for the action of atropine or scopolamine. The practice of leaving an order for these drugs to be administered "on call" to the operating room is condemned. When this is done the patient arrives in the operating room with no benefit from his preoperative medication, which then exerts its effect after the anesthetic has begun, at an undesirable time during the course of a general anesthetic.

CONDUCTION ANESTHESIA

Local anesthesia results in less metabolic upset than is produced by any other form of anesthesia. Failures of a well chosen local anesthetic cannot be attributed to deficiencies of the method, but rather to a lack of ability by the person performing it. There are limitations to its use in the hands of most urological surgeons, and recognition of these will obviate undeserved condemnation of the method. Most blocks are not difficult to learn, however, and the time and study spent in perfecting them will very likely be repaid on numerous occasions. The proportion of bad risk cases is probably as high in urological surgery as in any other group and in many instances it is desirable to obtain the advantages which local anesthesia affords. Its particular advantage is that since only the nerves to the area being operated upon are affected, physiological mechanisms in other areas are not disturbed. When significant disease of other organs is present and an adequate block can be performed, it will very likely be the anesthetic of choice.

Space limitations do not permit full description of the various blocks, but they are adequately described in texts on conduction anesthesia.

Certain basic principles can be listed and should always be adhered to.

Precautions

(1) Proper premedication to sedate patients and guard against reaction to the drugs.

(2) Solutions of proper strength and proper dosage of the drugs used. Two per cent procaine for large nerve trunks as in a caudal block. One per cent procaine in other blocks. One half or one quarter per cent for infiltration. Total dosage about one gram, this must be reduced in elderly individuals.

(3) Use of vasoconstrictors. Epinephrine 1 to 200,000. Vasoconstriction promotes safety by slowing down absorption of the drugs and also prolongs their action. A stronger dilution of vasoconstrictant may produce a reaction which may be inaccurately attributed to the local drug.

(4) Careful technique. Gentleness is important. Aspirate in two planes to prevent deposition of the drug in blood vessels or into the subarachnoid space in the case of caudal or paravertebral block. Do not inject the entire content of a syringe without aspirating several times.

(5) Prompt recognition and treatment of reactions. All drugs used in local anesthesia are toxic and are tolerated only when they gain entrance into the blood stream sufficiently slowly. Signs and Symptoms: A feeling of apprehension, nervousness and excitability, pallor, nausea, and vomiting, progressing in severe reactions to convulsions, respiratory and cardiovascular collapse, and death. Treatment· The administration of a quick-acting barbiturate, such as Pentothal This will control the convulsion, then administer oxygen. Administer a vasopressor and intravenous infusion in cases of fall in blood pressure.

Caudal Block.—Anesthetizes the sacral divisions of the spinal nerves and provides anesthesia of the perineum; may be used for any operation in this area, such as a transurethral resection. The block should be completed fifteen to twenty minutes before the time of operation in order to allow it to become effective; if Xylocaine is used, this time interval is greatly shortened.

Paravertebral Block.—Anesthetization of the first lumbar and the 10th, 11th, and 12th thoracic segments will block the areas involved in renal and ureteral surgery, in cases where there is involvement of several organ systems so that a formidable operative risk is presented, this technique can be used to advantage. It is relatively more difficult than other blocks, but can be learned with a reasonable amount of study and practice. A possible complication which must be guarded against is the deposition of the drug subarachnoidally into a sleeve of dura running along the spinal nerve outside the paravertebral foramen

Abdominal Block.—Provides adequate anesthesia for procedures such as suprapubic cystostomies and, in conjunction with a caudal block, for suprapubic prostatectomies Three wheals are made on each side from the umbilicus to the anterior-superior iliac spine. Insert needles through the fascial layer into the muscular layer, and deposit 8 c c. of 1 per cent solution in each location, the wheal at the anterior-superior iliac spine should be about 1 fingerbreadth medial to it, in this area the ileo-inguinal and ileohypogastric nerves are blocked. Connect the wheals with an intra- and subcutaneous injection of ½ per cent solution, and inject the same solution intra- and subcutaneously at the site of the operative incision. Inject ½ per cent solution, 20 c c., just above the pubis into the space of Retzius.

The technique of transurethral installation of local anesthetics and of local infiltration for circumcision is familiar to all urologists.

Spinal Anesthesia.—This has been found to be a most valuable technique One great advantage is that a considerable proportion of urological operations may be done with a relatively low level of anesthesia, and it is under these conditions that the spinal is safest and most satisfactory. It is very likely safe

to use for all operations in the perineal area, except in debilitated patients or those in shock or with a marked anemia or with a disease of the central nervous system, extremes of blood pressure, either very high or under 100 mm of mercury, systolic, are also generally regarded as being a contraindication Spinal anesthesia may also be most valuable for renal and ureteral surgery but if there is doubt of the ability of the anesthetist to produce an adequate block in this area and properly care for the patient afterward, another form of anesthesia should be used When spinal anesthesia ascends into the upper abdomen there is always some fall of blood pressure, with attendant strain on the cardiovascular system and this may be very poorly withstood by elderly individuals In addition, there is always the possibility of some impairment of respiration Cognizance of the hazards of spinal anesthesia will prevent most complications and result in intelligent handling of those that do occur

Precautions

(1) Premedication sufficient to give sedation
(2) A vasopressor before institution of the anesthesia 20 to 50 mg of ephedrine intramuscularly
(3) Start an intravenous infusion immediately after administration of the spinal anesthetic
(4) Have an oxygen mask and rebreathing bag already assembled, and make certain that the oxygen supply is turned on and is adequate
(5) Correct dosage of drugs
(6) Correct level of anesthesia Factors which determine the level of anesthesia are (a) Dosage—100 mg of procaine is adequate for most urological operations (b) Volume—2½ c c for perineal surgery (c) Speed of injection—½ c c per second (d) Position of the patient relative to the baricity of the drug injected
(7) Blood pressure, pulse, and respiration checked frequently
(8) Careful observation of the patient's color, general appearance, and respiration

Reactions—Anoxia is the ultimate factor which produces damage to the patient In treating reactions the object is to prevent this For a fall in blood pressure give a rapid intravenous infusion or a blood transfusion when indicated and intravenous vasopressors, such as 20 mg of ephedrine An intravenous drip of Neo Synephrine, 1 c c per 1 000 c c of solution, may be used with a careful check of the blood pressure Do not give vasopressors intramuscularly as this route is too slow Give oxygen by mask When respiration appears inadequate, it may be augmented by a pressure on the rebreathing bag while the mask is held firmly on the face Be certain that the patient has a patent airway, this may require the insertion of a rubber airway If a major reaction occurs respiration will stop entirely, and in these instances an endotracheal tube should be inserted, in such an instance this procedure is not difficult because of the lack of reflexes Always have all drugs and equipment which may be needed to treat a reaction assembled and ready to

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airway, Pentothal should not be used. In the presence of emphysema or other lung diseases, it is also contraindicated. Cardiac decompensation may be aggravated by Pentothal anesthesia. It may produce undue depression where there is a significant degree of anemia or hemorrhage. It is a poor anesthetic for patients in shock. Possibly because the liver is the main site of breakdown of Pentothal, disease of this organ is usually considered to be a contraindication. Pentothal should be given to small children only by those who are well versed in its use.

Intravenous anesthesia may be extensively used for such procedures as cystoscopies, the passage of sounds, and transurethral operations. When correctly administered it produces very little alteration of body metabolism. It should be used concomitantly with oxygen and nitrous oxide, about 1 liter per minute of each. Advanced age is not of itself a contraindication to the use of Pentothal, but it should be given to such patients with great circumspection and with the realization of the fact that only a fraction of the amount of Pentothal given a robust patient is required for elderly individuals. A safe technique is the administration of 2 c.c. of Pentothal per minute, with careful observation of the patient's vital signs until the desired level of anesthesia is reached. During any period of apnea or in case of an alteration of blood pressure or pulse, there should be no further administration until the change has been carefully evaluated. Pentothal produces very quiet respiration, so that obstruction to the airway may go unnoticed if it is not carefully guarded against.

Trichlorethylene is a potent analgesic. There are self-administering devices on the market, which deliver a low and safe concentration of vapor, useful for minor, painful procedures. Trichlorethylene should be used in an anesthesia machine to supplement other forms of anesthesia only by one who understands its use thoroughly. The vapor is nonexplosive.

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use, if they are needed at all, they will be needed at once. The most valuable time available to combat a reaction is in the period immediately after it has occurred

Drugs.—Procaine crystals mixed with spinal fluid provide a solution which is always hyperbaric. Another hyperbaric solution which is just as safe and will provide a somewhat longer period of anesthesia is a mixture of Pontocaine and procaine solution, in the ratio of 1 mg. of Pontocaine to 5 of procaine. Two cubic centimeter ampules of 10 per cent procaine and 1 per cent Pontocaine may be obtained. For instance, 10 mg. of Pontocaine and 50 mg. of procaine can be used; this dosage should probably not be exceeded, and, in many instances, a smaller dosage in the same ratio should be used.

GENERAL ANESTHESIA

Inhalation.—Cyclopropane is explosive, which eliminates its use where electrosurgical apparatus is also being used. However, it can be used in almost any other situation and is especially valuable for certain poor-risk patients. It is the most suitable general anesthetic for patients in shock or those who are hemorrhaging or those who have a significantly low hemoglobin It has the least effect on blood pressure of any general anesthetic. It is nonirritating, so that induction with it is not objectionable. It is potent, so that any patient may be anesthetized. It is readily controllable and is rapidly eliminated and is comparatively nontoxic. An abundance of oxygen is administered with it These characteristics make it suitable for patients with heart disease, except in the presence of a serious arrhythmia In the ordinary patient, a high concentration of cyclopropane will increase myocardial irritability and result in serious arrhythmias, but this is not necessary with the techniques available today. Because of the high concentration of oxygen administered with it, it is suitable for many patients with respiratory disorders However, it does produce some depression of respiration, especially when used concomitantly with other drugs, so that there is some possibility of a build-up of carbon dioxide. It has little effect on the liver and other metabolic functions. Its effect on the kidneys is to produce a temporary oliguria, followed by a compensatory diuresis, so that the result is little disturbance of renal function. It does not produce satisfactory relaxation for abdominal procedures when used alone, but a small amount of ether or the use of a muscle relaxant in competent hands will provide this.

Ether has long been regarded as the safest inhalation agent, and in inexperienced hands this is undoubtedly true Disadvantages are postoperative nausea and vomiting with loss of fluids and electrolytes, production of acidosis and hemoconcentration, glycogenolysis, and some impairment of liver and kidney function. Ether vapor is explosive

Intravenous Anesthesia.—This is a very useful technique for urological surgery. However, because of its ready acceptability by the patient and the ease of administration, contraindications to its use are sometimes disregarded, with disastrous results. Where there is any question of obstruction to the

incisions for exposure of the kidney must traverse this space The twelfth thoracic nerve passes along the superior boundary of this triangle, while the ilio inguinal and iliohypogastric nerves go along the posterior border and cross the inferior angle It is important that these nerves be preserved from injury during operation

On the same plane with the internal oblique muscle are found the sacro spinalis and the serratus posterior inferior The sacrospinalis or erector spinae muscle lies in the groove along the spinous processes of the vertebral column It is enclosed in a fibrous sheath formed by the posterior and middle layers of the lumbodorsal fascia This muscle lies along the posterior border of most lumbar incisions for exposure of the kidney It is not necessary to include its fibers in the incision

The serratus posterior inferior is a thin, flat quadrangular muscle which crosses the upper posterior angle of the lumbar area immediately beneath the latissimus dorsi and overlies the posterior lumbocostal ligament It arises from the dorsal layer of the lumbodorsal fascia and is inserted into the lower four ribs It is sometimes necessary to divide the lower fibers of this muscle as well as the underlying ligament so that the twelfth rib may be retracted upward for better exposure of the kidney Care should be taken to avoid injury to the pleura which sometimes descends below the twelfth rib in this area

The quadratus lumborum muscle lies beneath and partly external to the sacrospinalis muscle It arises below from the iliac crest and from the iliolumbar ligament and passes upward to be inserted into the twelfth rib It is contained within the fibrous compartment formed by the middle and anterior layers of the lumbodorsal fascia This muscle is seen in the posterior border of kidney in cisions It may be retracted posteriorly if necessary, but it is rarely necessary to divide its fibers The iliohypogastric and ilio inguinal divisions of the first lumbar nerve emerge beneath the quadratus lumborum near its insertion and pass along the inner surface of the muscle for a varying distance before passing anteriorly, the iliohypogastric to pierce the fibers of the aponeurosis of the transversalis muscle and the ilio inguinal to enter the transversalis muscle The course of these nerves varies in different individuals It is important to avoid them when making an incision and when suturing the wound

Beneath the internal oblique muscle anteriorly and beneath the serratus posterior inferior muscle posteriorly and above lies the aponeurosis of the trans versus abdominis (transversalis) muscle This aponeurosis, sometimes spoken of as the lumbar fascia, is formed by the fusion of the three leaves of the lumbo dorsal fascia which envelop the sacrospinalis and quadratus lumborum muscles as they pass from the lumbar spinous processes to unite along the external borders of these muscles This aponeurosis forms the floor of the surgical lumbar triangle and is divided in all lumbar incisions for exposure of the kidney Im mediately beneath the aponeurosis posteriorly one will *find the ilio inguinal* and iliohypogastric nerves Immediately beneath the aponeurosis is a layer of

CHAPTER V

SURGICAL APPROACH TO THE KIDNEY. INCISIONS FOR OPERATIONS ON THE KIDNEY

Anatomy: Lumbar Incision; Vertical Incision; Resection of Twelfth Rib; Dorsolumbar Flap Incision; Abdominal Incision

SURGICAL APPROACH TO THE KIDNEY

Surgical access to the kidney is usually obtained through the lumbar or iliocostal region This is a quadrilateral area between the lowermost ribs and the crest of the ilium. The vertebral column forms the posterior boundary and the anterior boundary is formed by a vertical line from the anterior superior spine of the ilium to the costal margin The superficial structures in this area consist of the skin and two layers of superficial fascia between which is a thick layer of lobulated fat. Extensive suppuration may occur in this area, resulting from neglected abscesses deep in the lumbar area Blood vessels and nerves in this superficial structure are of no surgical importance

Lying on the same plane and immediately beneath the deep layer of the superficial fascia are the latissimus dorsi and external oblique muscles The latissimus dorsi arises from the posterior third of the outer edge of the iliac crest, from the lumbar and sacral spinous processes, and from the dorsal leaf of the lumbodorsal fascia It passes upward and forward, crossing the posterior superior portion of the iliocostal region In most operations upon the kidney, the anterior fibers of this muscle must be cut to give adequate exposure The fibers of the external oblique muscle, which arise from the ninth, tenth, eleventh and twelfth ribs, descend obliquely downward and forward, crossing the antero-inferior portion of this area. In the upper portion of the area the anterior fibers of the latissimus dorsi overlap the posterior fibers of the external oblique. The external oblique may be divided when necessary to expose the kidney satisfactorily. The incision should be made almost parallel to the lower ribs to prevent cutting nerves and blood vessels In the lower portion of this area the fibers of these muscles diverge to form the inferior lumbar triangle (Petit's triangle). The base of this triangle is a portion of the iliac crest and the internal oblique muscle makes its floor The superior or surgical lumbar triangle lies above and medial to Petit's triangle. It is bounded above by the twelfth rib, posteriorly by the depression along the lateral margin of the sacrospinalis muscle, and below by the posterior fibers of the internal oblique muscle which arises from the iliac crest and the inferior portion of the lumbodorsal fascia and passes upward and forward immediately beneath the external oblique The posterior fibers of this muscle are usually divided during operations upon the kidney. The superior triangle lies immediately beneath the latissimus dorsi and its floor is formed by the aponeurosis of the transversus abdominis muscle All lumbar

incisions for exposure of the kidney must traverse this space The twelfth thoracic nerve passes along the superior boundary of this *triangle*, while the ilio inguinal and iliohypogastric nerves go along the posterior border and cross the inferior angle It is important that these nerves be preserved from injury during operation

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fat which separates it from the perirenal fascia. The perirenal fascia is a part of the fascia propria which reinforces the peritoneum. This fascia when reaching the kidneys divides into a posterior and an anterior layer to envelop the kidneys The posterior layer known as Gerota's or Zuckerkandl's fascia is thicker and more resistant than the anterior layer. At the inner border of the kidney these layers unite and the blood vessels and lymph nodes of the pedicle are enclosed in fibrous extensions At the upper pole of each kidney the layers of fascia enclose the corresponding adrenal gland When the adrenal gland is to be exposed at operation, it is important to leave the renal fascia intact. By separating the fascia posteriorly and making downward traction on the kidney and fascia together, the gland can be more easily exposed. At the lower pole of each kidney the leaves of the fascia fuse incompletely to enclose the ureter, forming the periureteral sheath. The renal fascia is separated from the kidney by a layer of fat which is almost absent in children and varies greatly in thickness in adults, and is more abundant posteriorly and at the lower pole. Many fibrous bands pass from the renal fascia to the true capsule of the kidney. These are more abundant at the upper and lower poles.

The psoas major muscle runs posterior to the kidney, forming a buffer between the kidney and the vertebral column. This muscle, after arising from the twelfth thoracic and all the lumbar vertebrae and passing downward and laterally along the pelvic brim, goes beneath the inguinal ligament and is inserted into the lesser trochanter of the femur. The muscle is not disturbed when operating upon the kidney. Its insertion into the femur may cause flexion of the thigh when the muscle is irritated by perirenal suppuration or by extravasation of blood or urine.

INCISIONS

The kidney is usually exposed extraperitoneally through the lumbar (iliocostal) region. A number of incisions have been advocated as most nearly meeting the requirements of adequate exposure with the least damage to overlying structures. It is necessary to make the incision to comply with anatomical and pathological variations in different patients.

The Lumbar Incision

The incision we most frequently use is made by beginning over the twelfth rib at the costovertebral angle. The incision is carried downward and forward at an acute angle to the twelfth rib to a point just above the crest of the ilium. From here it may be continued forward parallel to the crest of the ilium as the indications may demand (Fig. 82). When the skin and superficial fascia are divided, the latissimus dorsi and the external oblique muscles are exposed and between the two posteriorly is the upper angle of Petit's triangle (Fig 83) The latissimus dorsi muscle is then divided as far upward as necessary to give adequate exposure at the upper angle of the wound. At least a portion of the serratus posterior inferior muscle which lies beneath the latissimus dorsi is

divided at the same time This exposes the superior lumbar triangle and the lumbar fascia The posterior fibers of the external and internal oblique muscles which cross the lower portion of the wound are divided when necessary The extent of the incision in these muscles depends upon the build of the patient and the size of the kidney to be exposed Usually these muscles may be left intact and retracted forward sufficiently to give ample room below It is often necessary to divide them for at least two or three inches in very muscular patients (Figs 84 and 85) After these muscles have been divided, all bleeding is controlled before opening the lumbar fascia (The operation proceeds much more satisfactorily if no bleeding areas are left to constantly soil the wound) The transversalis (lumbar) fascia is next incised, and the ilio inguinal and iliohypo

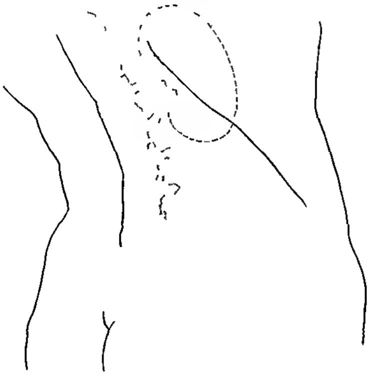


Fig 82—Lumbar incision for exposure of the kidney The incision may be extended further forward when indicated

gastric nerves are identified and protected If the incision has been made properly they will lie just below the posterior margin of the wound and are reflected with the posterior segment of the lumbar fascia (Fig 86) Before proceeding further it should be determined whether or not there is sufficient room to carry out the necessary operative procedure If necessary, additional space may be provided at both ends of the incision The posterior part of the twelfth rib may be cleared back almost to the articulation of the rib with the twelfth dorsal vertebra and the attachments of the quadratus lumborum and the lumbocostal ligament divided This permits the twelfth rib to be retracted upward and outward and greatly increases the space at the upper angle of

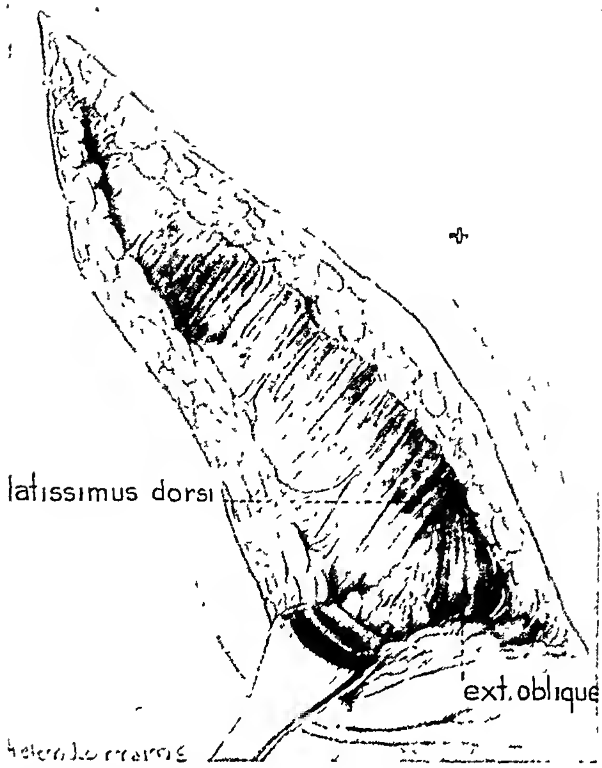


Fig 83 —The skin and superficial fascia have been divided, exposing the external oblique muscle anteriorly and the latissimus dorsi muscle in the posterior portion of the wound. The apex of Petit's triangle is seen at the lower margin of the wound

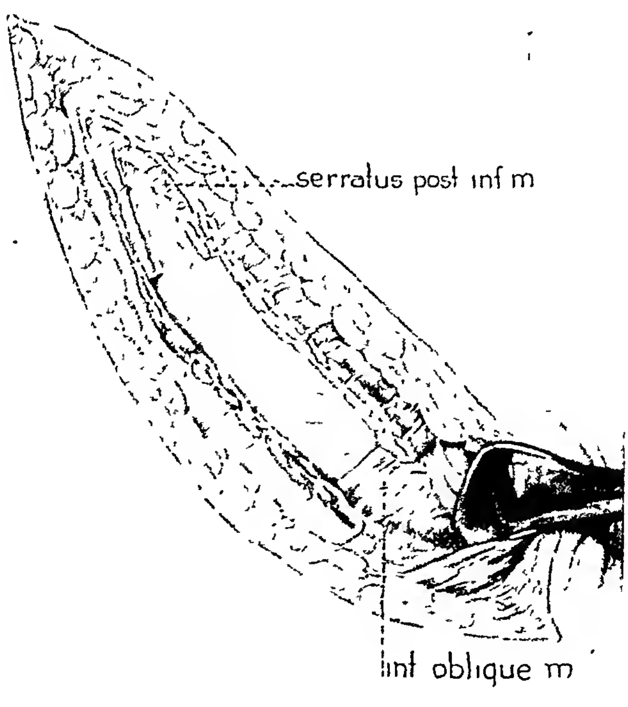


Fig. 84 —The latissimus dorsi muscle has been divided up to the twelfth rib, exposing the serratus posterior inferior muscle, a portion of which has also been divided. Retraction of the external oblique muscle exposes the internal oblique The aponeurosis of the transversalis muscle (lumbar fascia) is seen in the depth of the wound

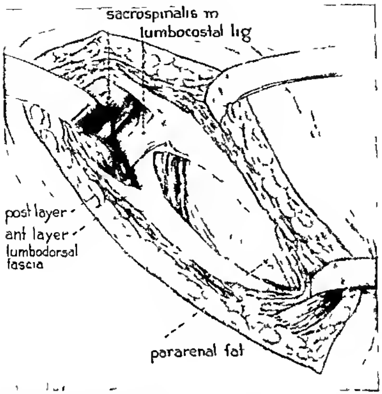


Fig 85—The posterior fibers of the internal oblique muscle and the lumbar fascia have been divided exposing the fat and fascia which surround the kidney In the upper angle of the wound the lumbocostal ligament is exposed This ligament should be divided for better exposure at the upper angle of the wound

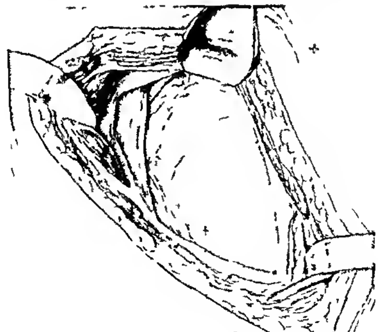
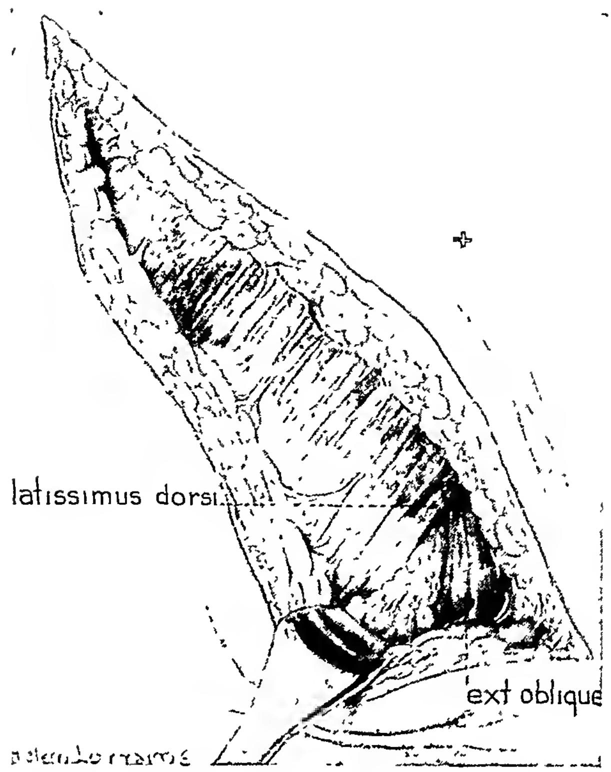


Fig 86—The kidney covered by fat and fascia adequately exposed



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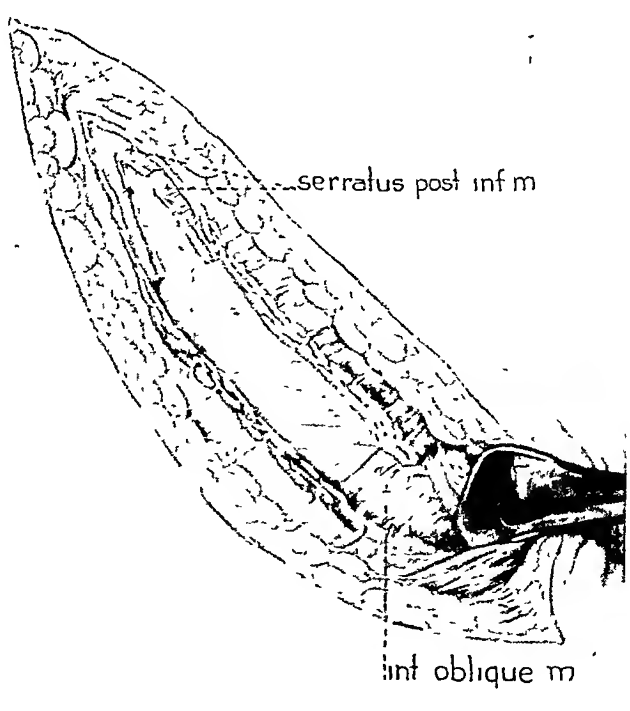

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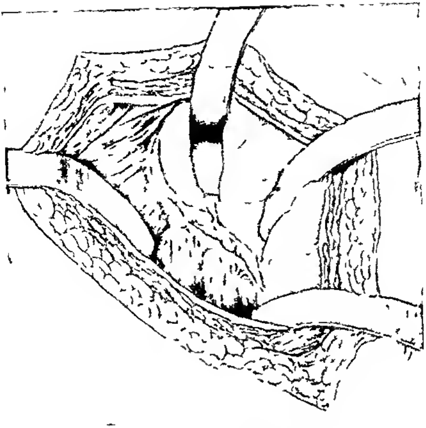


Fig 87—The perirenal fascia dissected from the muscles posteriorly and incised near the hilus of the kidney

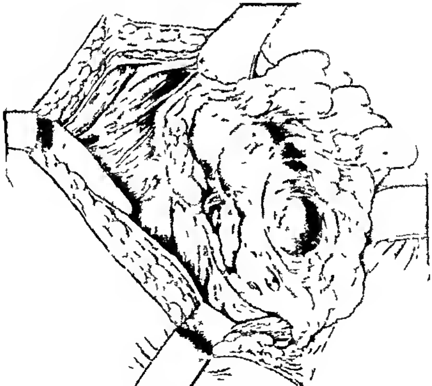


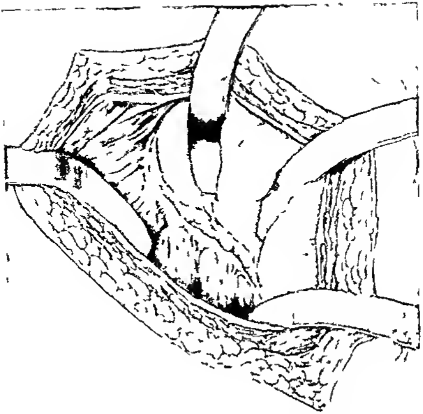
Fig 88—Fat and fascia being dissected from the kidney are preserved intact for use in giving the kidney support when it is returned to its bed

the wound. In making this dissection it is important to push the pleura upward to prevent injuring it. If the pleura is injured a sucking sound is immediately heard. The finger should be passed beneath the rib and the opening closed by pressing it against the rib until it can be repaired Attempts to close the injury by grasping the margins with hemostats inevitably results in making the opening larger A mattress suture of No. 0 plain catgut will usually close the rent successfully. When freeing the twelfth rib posteriorly the twelfth thoracic artery should be protected, for when it is injured it bleeds rather profusely. When injured it should be grasped with a hemostat and transfixed with No. 0 plain catgut. If after mobilizing the twelfth rib still more room is needed, the incision may be extended anteriorly. The finger is inserted beneath the transversalis fascia at the lower end of the wound and the peritoneum is pushed forward as the abdominal muscles are divided sufficiently to give adequate exposure

The perirenal fascia is next separated from the quadratus lumborum and psoas muscles from the lower to the upper pole of the kidney and medial to the kidney pedicle. It is now incised throughout its length as far posteriorly as practical (Fig 87) and the anterior flap is stripped from the kidney and retracted anteriorly (Fig 88) The perirenal fat should be left attached to the fascia in so far as possible except in tuberculosis or malignant disease This fat and fascia if preserved intact may be used to cover and support the kidney when the operation is completed. It is not necessary to remove the fat when the kidney is to be removed.

This incision is satisfactory for all operations upon the kidney except for the removal of large malignant tumors, which should be approached transperitoneally.

Closing the Wound.—Closing the wound after a nephrectomy is always an important part of the operation When the kidney has been removed, the wound margins should be retracted and the entire cavity should be inspected carefully for bleeding vessels or evidence of injury to adjoining structures. All bleeding vessels must be ligated, the stump of the pedicle examined, and the ligatures reinforced if they seem to be inadequate The most inaccessible portions of the wound should be explored for gauze sponges. If the wound has been contaminated by infectious material, it should be flushed out with an antiseptic solution. I have had very few wound infections following the use of one per cent Mercurochrome or tincture of Metaphen. Powdered sulfanilamide also seems to diminish infection when purulent material has invaded the wound If the wound has been contaminated by material from a tuberculous kidney or a malignant tumor, the wound should be flushed with a solution of 70 per cent alcohol. The excess of solutions used to flush the cavity should be aspirated or sponged out with gauze. When the wound has been inspected and prepared for closure, the elevator is lowered, releasing tension on the wound, and the different layers of the wound are closed separately and accurately. Probably the two most frequent causes of postoperative hernia are injury to nerves and



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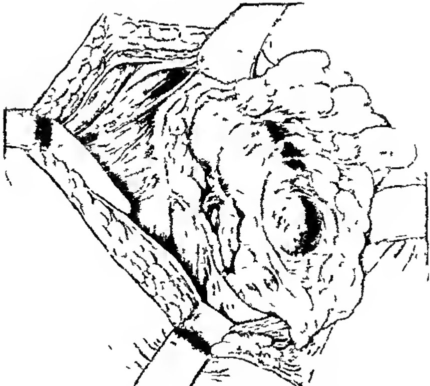

Fig 88 —Fat and fascia being dissected from the kidney are preserved intact for use in giving the kidney support when it is returned to its bed

failure to suture accurately the lumbar fascia. If the twelfth dorsal, the ilio-inguinal or the iliohypogastric nerve has been divided, the ends should be approximated with fine silk. When suturing the wound, care must be taken to avoid catching these nerves in the suture. In all lumbar incisions for exposure of the kidney, at least one of these nerves is in close proximity to the margin of the wound. After closing the lumbar fascia with a continuous suture of No. 0 chromic catgut (Fig. 89) the muscles are united with interrupted sutures of the same material, taking deep bites to prevent the sutures from tearing out. The individual muscles are sutured separately and the approximation should be as

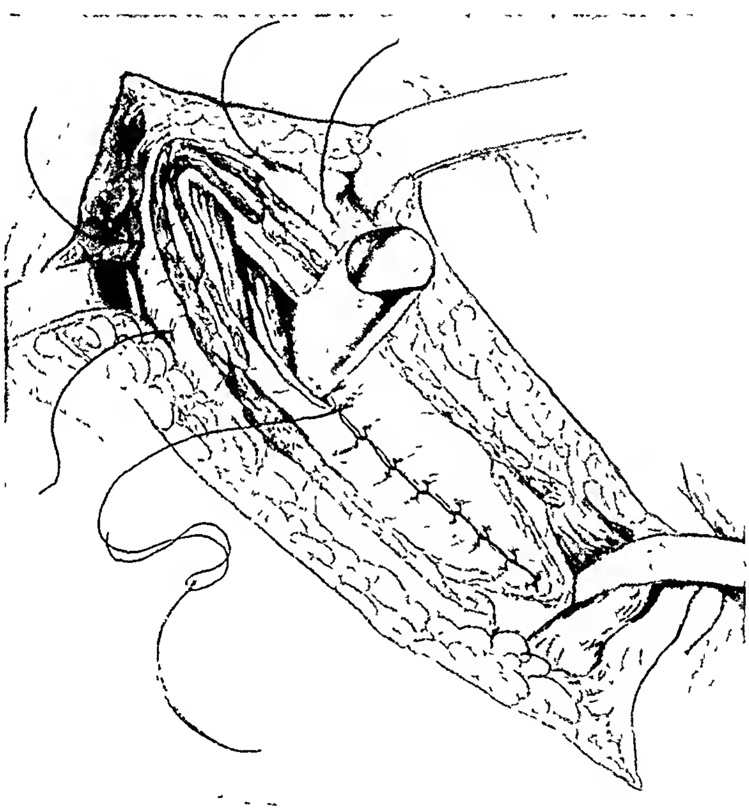

Fig 89.—The lumbar fascia is closed by a continuous suture, usually 0 chromic catgut is satisfactory. At the upper angle of the wound interrupted sutures including all subcutaneous structures are satisfactory.

accurate as possible (Figs. 90 and 91). The superficial fascia may be closed with a continuous suture of No. 1 plain catgut, and if there is much fat this should be approximated with a few interrupted sutures of plain catgut to prevent dead space and to prevent tension on the cutaneous sutures. The skin may be closed with 00 chromic catgut or silk. The latter causes less irritation. Deep silkworm gut sutures in loin incisions, in my experience, are frequently accompanied by stitch abscesses. If drainage is used, the tubes should emerge near the upper end of the wound; this lessens the probability of hernia. A small Penrose drain left about three days is usually sufficient. If the wound is infected, a soft rubber tube projecting just within the cavity should be used

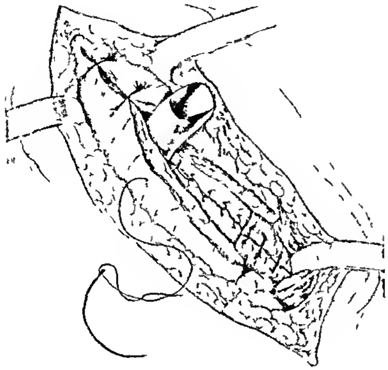

Fig 90—Method of accurately approximating each muscle layer

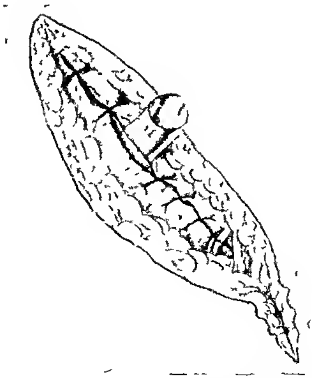

Fig 91—After the muscles are closed the superficial fascia is approximated by fine catgut sutures and the skin with silk or other nonabsorbable material

The Vertical Incision of Simon

This incision is made just mesial to the lateral edge of the erector spinae muscle and extends from the twelfth rib downward to near the crest of the ilium (Fig. 92) The posterior sheath of the erector spinae muscle is divided and the muscle retracted toward the vertebra, thus the anterior fascial sheath which constitutes the posterior covering of the quadratus lumborum is exposed. This layer of fascia is divided throughout the length of the wound together with the anterior sheath of the quadratus lumborum just before they blend with the posterior sheath of the sacrospinalis to continue forward as the lumbar fascia. The ilio-inguinal and iliohypogastric nerves are identified as they pass along the posterior wall of the wound and are protected from injury. The iliac fascia is now divided, exposing the perirenal fascia, which is divided as previously described.

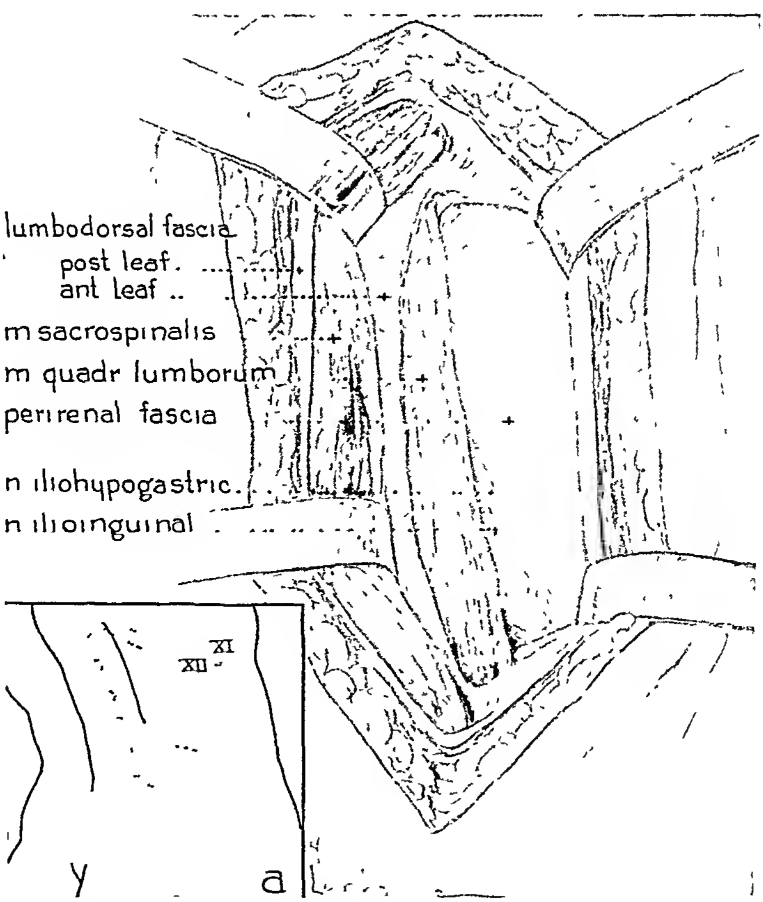

Fig 92—The Simon-Young incision for exposing the kidney The dotted line in the insert indicates extension of the incision when necessary as proposed by McClure Young.

The advantages of this incision are that it avoids injury to important structures, there is very little bleeding and no danger of hernia It also gives a direct approach to the kidney. It is particularly satisfactory in tall, thin patients with adequate space between the twelfth rib and the crest of the ilium. It is unsatisfactory if the kidney is appreciably enlarged or if the patient is very stout or short of stature.

H McClure Young advocates a similar incision with an extension forward when necessary about an inch above and parallel to the crest of the ilium This permits a flap of the abdominal wall to be turned forward and gives excellent access to the kidney even in very stout patients

Resection of the Twelfth Rib

One of the most satisfactory incisions for exposure of the kidney is one that includes resection of the twelfth rib The incision has the advantage of being directly over the central part of the kidney There is no danger of injuring the twelfth thoracic or first lumbar nerves and space can be obtained for dealing with almost any renal pathology, even fairly large tumors There is probably more danger of injuring the pleura, but with proper care this can be avoided

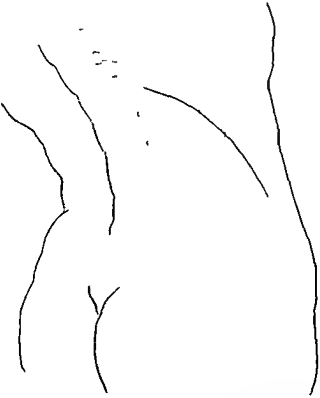

Fig 93 —Line of incision for exposure of the kidney by resection of the twelfth rib

The incision is made directly over the twelfth rib and extends from about the external margin of the sacrospinalis muscle to a little beyond the tip of the rib (Fig 93) The incision is carried down to the rib, dividing the anterior fibers of the latissimus dorsi and a portion of the serratus posterior inferior muscle in the posterior portion of the incision and a portion of the external and internal oblique muscles anteriorly These structures are then retracted, while the rib is being freed from its attachment to the fascia and muscles A satisfactory method is to use a fairly sharp periosteal elevator and, beginning in the midline of the rib scrape the muscle attachments along with the periosteum toward each edge until the anterior surface of the rib is free The attachments of the inter

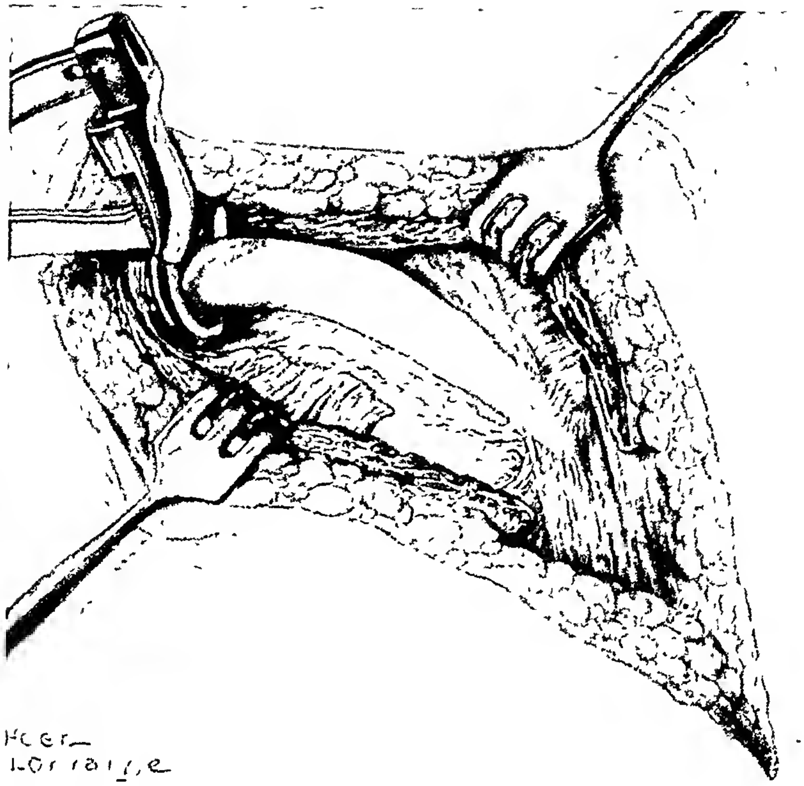

Fig. 94.—Skin, fascia, and muscles are divided directly over the rib and all attachments to both upper and lower margins of the rib are separated with a periosteal elevator, keeping close to the rib and removing as much of the periosteum as can easily be separated. Soft tissues are retracted and the rib is cut posteriorly beneath the lateral margin of the spinal muscles.

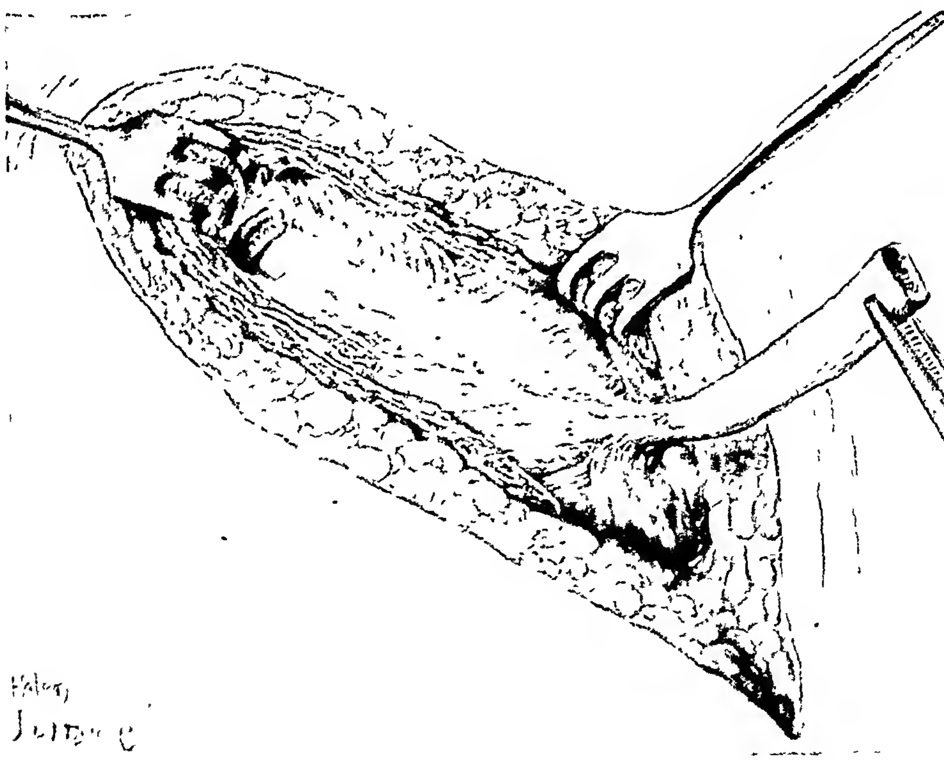

Fig. 95.—The rib is dissected from muscular attachments near its tip and the incision extended forward and downward as far as necessary to obtain good exposure. The aponeurosis of the transversalis (lumbar fascia) lies beneath the rib and is exposed when the rib is removed.

costals are then separated from the anterior half of the upper margin of the rib and the attachment of the external oblique is likewise separated from its lower margin The rib is next freed from the fibrous attachments to its lower surface near the tip so that the lower curved blade of the rib resector can be inserted from below upward The rib resector is then pulled up *against the rib and* drawn sharply backward, effectively dividing all fascial and muscular attachments that have not previously been divided The rib is cut off as close to its spinous attachment as possible (Fig 94) The tip of the rib is now carefully dissected free (Fig 95) The incision is extended anteriorly as far as is considered necessary, dividing the involved portion of the external and internal oblique muscles The transversalis fascia is identified and opened near the *anterior angle of the wound* The peritoneum is pushed toward the midline and

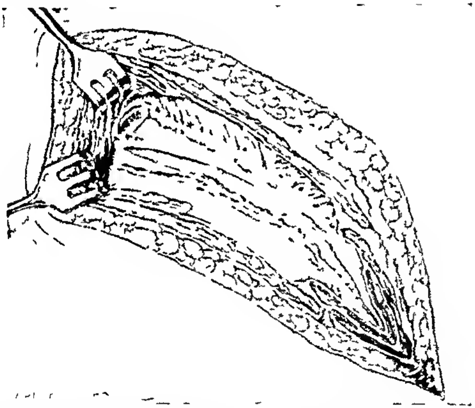

Fig 96 —Lumbar fascia divided exposing the perirenal fascia The twelfth dorsal vessels and nerves run along the lower margin of the wound just beneath the lumbar fascia

the transversalis muscle is divided to the anterior extent of the wound (Fig 96) Hess advises that the opening in the transversalis fascia be enlarged posteriorly by using the index finger of each hand to tear it evenly This protects the diaphragm and pleura from direct injury The kidney is now easily palpable beneath the perirenal fascia and the operation may proceed according to indications There is no particular advantage in attempting to remove a portion of the periosteum of the rib except that in so doing the surgeon works always against the rib and is not apt to injure adjoining structures If the pleura is opened, the injured area should be held against the eleventh rib until the rent can be repaired Positive pressure anesthesia should be available

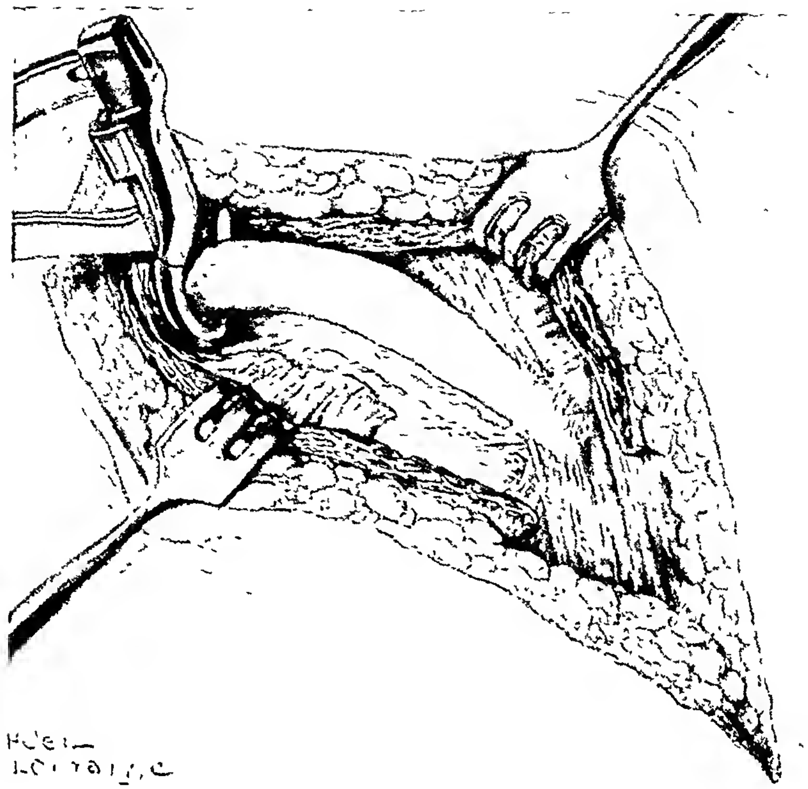

Fig 94 —Skin, fascia, and muscles are divided directly over the rib and all attachments to both upper and lower margins of the rib are separated with a periosteal elevator, keeping close to the rib and removing as much of the periosteum as can easily be separated Soft tissues are retracted and the rib is cut posteriorly beneath the lateral margin of the spinal muscles

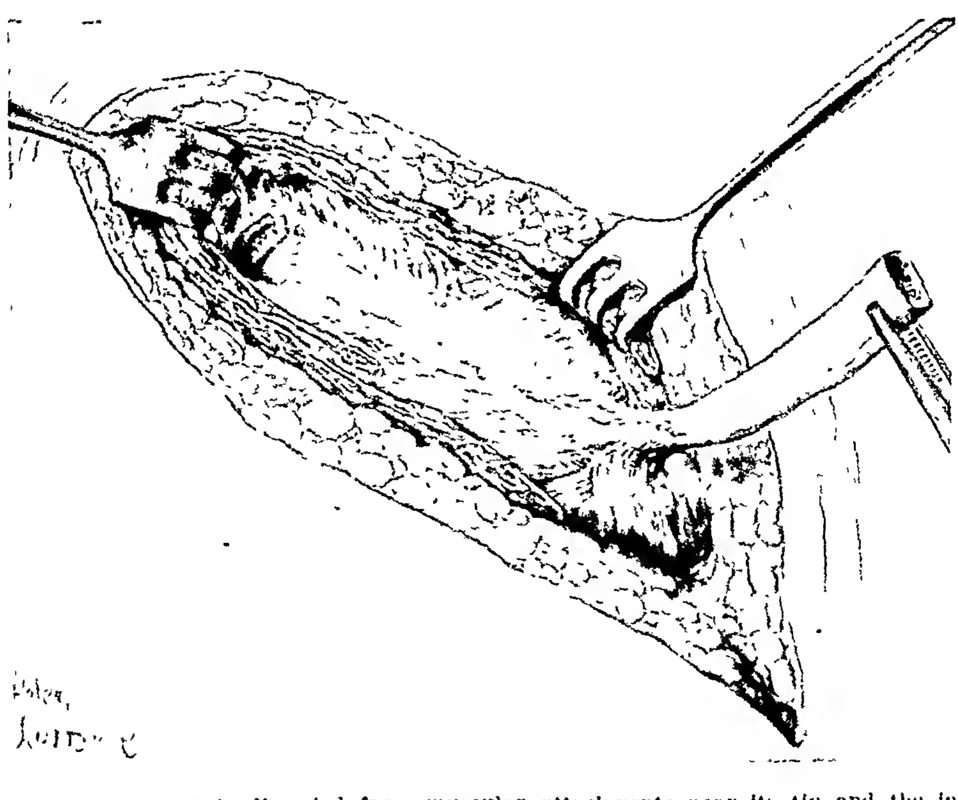

Fig 95 —The rib is dissected from muscular attachments near its tip and the incision extended forward and downward as far as necessary to obtain good exposure. The aponeurosis of the transversalis (lumbar fascia) lies beneath the rib and is exposed when the rib is removed

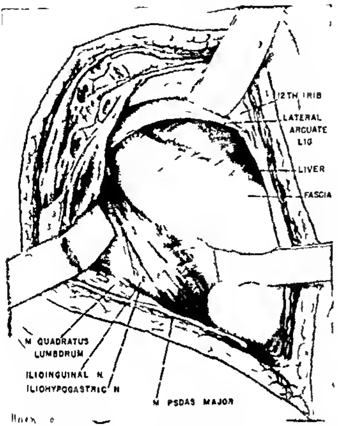

Fig 98—Lumbocostal ligaments divided exposing lateral arcuate ligament which when divided near its posterior attachment permits the lower ribs and diaphragm to be retracted upward

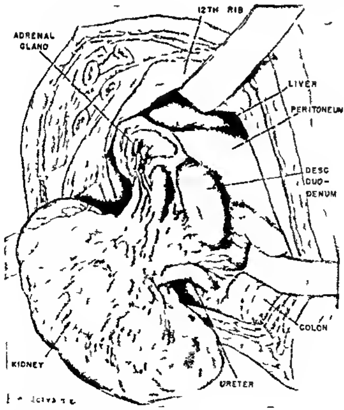

Fig 99—Extensive exposure provid d by the dorsolumbar incision

The Dorsolumbar Flap Incision

George R. Nagamatsu has described an incision devised to mobilize the lower ribs and diaphragm, thereby giving adequate exposure for the more difficult surgical procedures upon the kidneys and adrenal glands. The operation as described by Nagamatsu has a dorsal and a lumbar component. The dorsal component extends upward from the angle of the twelfth rib, parallel to the lateral border of the sacrospinalis muscle, to the interspace above the tenth rib. The latissimus dorsi and serratus muscles are divided, exposing the

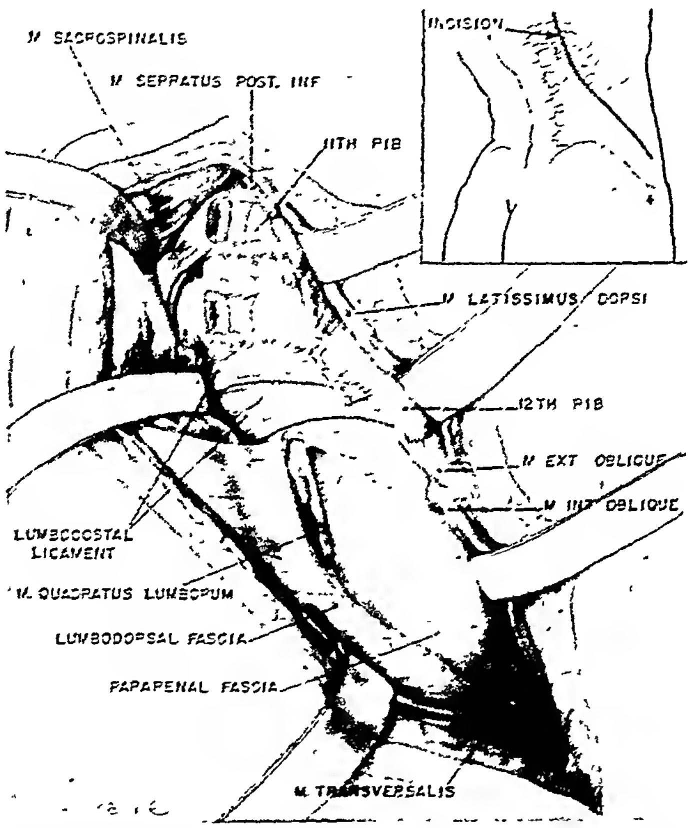

Fig. 97.—The dorsolumbar flap incision (Nagamatsu). Inset shows outline of incision. The incision may extend upward to expose the tenth rib and may be carried forward over the twelfth rib, depending upon the amount and type of exposure needed.

tenth, eleventh, and twelfth ribs just medial to their angles. The lower tendinous slips of the sacrospinalis muscle which are inserted near the angle of the ribs are also divided, if necessary, to expose the ribs. Segments of the ribs, about 2½ cm. in length, are excised just medial to the angles. The lumbar component of the incision extends from the dorsal component forward along the course of the twelfth rib, or forward and downward as illustrated here (Fig. 97), depending upon the exposure needed. The lumbar and abdominal muscles and/or aponeurosis are divided as in the usual lumbar incision. The costovertebral ligament is divided, exposing the lateral arcuate ligament, which is divided at its posterior extremity (Fig. 98).

tumor cells' being squeezed into the circulation during the manipulation of the kidney and to some extent prevents excessive bleeding during the liberation of the kidney

The incision begins just below the costal margin about three inches from the midline and is carried downward about an inch internal to the outer border of the rectus muscle to a point well below the lower extremity of the tumor (Fig 100) After dividing the skin, superficial fascia, and anterior sheath of the rectus muscle, the fibers of the muscle are separated, using the knife handle or the point of closed scissors Before proceeding further all bleeding points should be clamped and ligated Bleeding areas in the muscle are usually more easily controlled by transfixing the area with needle and fine plain catgut The suture should be tied only tightly enough to control the bleeding, or it may cut through The peritoneum is then opened by carefully making a small incision through the posterior sheath of the rectus and the peritoneum at the upper angle of the wound and inserting two fingers of one hand As the abdominal wall is elevated from the intestines, the incision through the peritoneum is extended to the lower end of the wound

The peritoneum just lateral to the colon is next incised This incision runs parallel to the colon for the length of the tumor The colon with its mesentery is carefully dissected from the anterior surface of the tumor and pushed toward the midline, together with the small bowel, and isolated from the operative area by gauze sheets Ligation of the kidney pedicle may now be accomplished without undue manipulation or tugging on the tumor

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The lower ribs and diaphragm may then be retracted upward, exposing the retroperitoneal space between the diaphragm and crest of the ilium. Difficult surgical procedures upon the kidney or adrenal gland are thereby greatly simplified (Fig. 99). In my experience adequate exposure has been obtained without the necessity of dividing the tenth rib. The illustrations shown here depict the principles but not all the details of the operation as originally described. The wound is closed as any other lumbar wound, taking care to approximate all structures accurately The divided ribs do not need any special attention. The excised segments prevent overriding.

I have found this incision of advantage only when operating upon the adrenal gland or for large renal tumors. For most cases of difficult renal surgery, resection of the twelfth rib gives adequate exposure With the patient in the supine position, this incision may be used for exposure of both adrenal glands or kidneys at the same time.

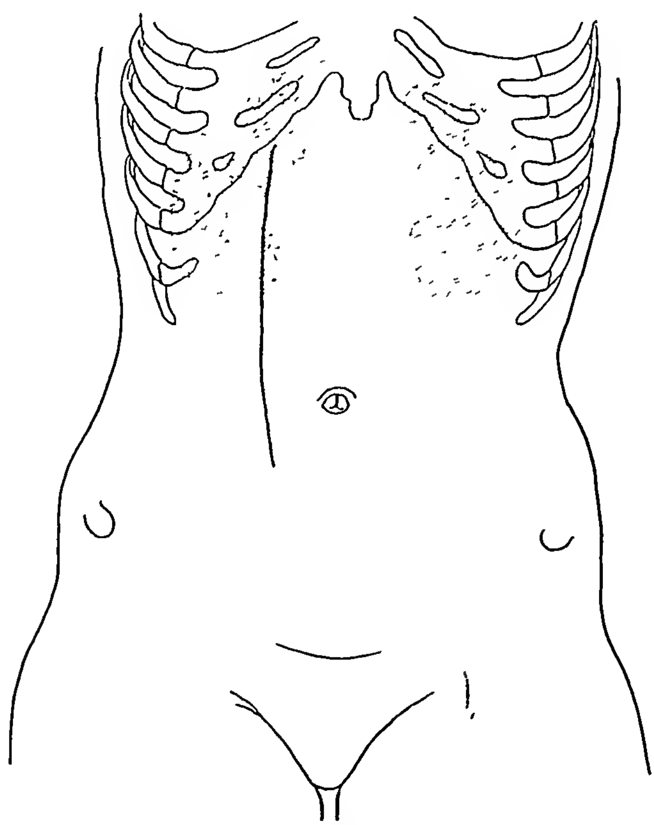

Fig 100—Line of incision for transperitoneal exposure of the kidney

Anterior Abdominal Incision

When nephrectomy is to be done because of a malignant growth, the kidney may be approached through an anterior abdominal incision. This is particularly advisable if the tumor is large because it permits more immediate access to the pedicle of the kidney. The renal vessels should be ligated and divided as the first step in a nephrectomy for malignancy. This prevents

tumor cells' being squeezed into the circulation during the manipulation of the kidney and to some extent prevents excessive bleeding during the liberation of the kidney

The incision begins just below the costal margin about three inches from the midline and is carried downward about an inch internal to the outer border of the rectus muscle to a point well below the lower extremity of the tumor (Fig 100) After dividing the skin, superficial fascia, and anterior sheath of the rectus muscle, the fibers of the muscle are separated, using the knife handle or the point of closed scissors Before proceeding further all bleeding points should be clamped and ligated Bleeding areas in the muscle are usually more easily controlled by transfixing the area with needle and fine plain catgut The suture should be tied only tightly enough to control the bleeding, or it may cut through The peritoneum is then opened by carefully making a small incision through the posterior sheath of the rectus and the peritoneum at the upper angle of the wound and inserting two fingers of one hand As the abdominal wall is elevated from the intestines, the incision through the peritoneum is extended to the lower end of the wound

The peritoneum just lateral to the colon is next incised This incision runs parallel to the colon for the length of the tumor The colon with its mesentery is carefully dissected from the anterior surface of the tumor and pushed toward the midline, together with the small bowel, and isolated from the operative area by gauze sheets Ligation of the kidney pedicle may now be accomplished without undue manipulation or tugging on the tumor

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CHAPTER VI

CONGENITAL ANOMALIES OF THE KIDNEY AND THEIR TREATMENT

Solitary Kidney; Hypoplasia; Ectopic Kidney; Horseshoe Kidney

Anomalies of the kidney are of considerable surgical interest. Absence or hypoplasia of one kidney may be a deciding factor in the treatment of a normal kidney (Figs. 170, 171, and 172), while anomalies affecting the locations of the kidneys or their relation one to the other present special problems of diagnosis and treatment Only those anomalies that are of surgical interest will be discussed.

CONGENITAL SOLITARY KIDNEY

One kidney is absent approximately once in 1,000 autopsies Occasionally the corresponding adrenal gland is also absent The ureter may also be absent or may end blindly. When the ureter is entirely absent the corresponding site of the trigone does not develop. The condition is occasionally associated with other anomalies of the genitourinary tract, including an anomaly in position of the opposite kidney.

The possibility of such anomaly must be remembered when surgical treatment of the kidney is necessary A number of cases have been reported in which a solitary kidney has been removed in an emergency. Trauma was the cause of nephrectomy in most cases. Nephrectomy is rarely so urgent that the presence and condition of the opposite kidney cannot be determined.

Even when the kidney is severely injured, immediate operation is not often necessary. Replacement of blood loss by transfusion and modern methods of treating shock will sustain the patient until necessary investigation can be made If because of complicating injuries or excessive bleeding preliminary examinations cannot be made, the presence of a second kidney should be determined by transabdominal palpation before nephrectomy is done.

Solitary kidney is occasionally recognized while examining patients with anuria Obstruction of the only kidney causes complete suppression of urine Prompt drainage through a ureteral catheter or by ureterostomy or nephrostomy is necessary. Congenital absence of the kidney is differentiated from hypoplasia of one kidney or bilateral renal disease by cystoscopic examination and pyelography

Occasionally congenital absence of one kidney is demonstrated by a roentgenogram showing enlargement of the renal shadow on one side with absence of a renal shadow on the opposite side

The treatment of disease of a congenital solitary kidney is the same as that of acquired solitary kidney. Operative treatment may be required to establish good drainage or to remove stones Resection of a diseased portion of an only kidney is occasionally indicated.

CONGENITAL HYPOPLASIA

Congenital hypoplasia occurs somewhat more frequently than congenital absence of the kidney In most cases the hypoplastic kidney is similar in structure to the normally developed kidney but is only a fraction of its size Occasionally the small kidney is a rounded mass with only one calyx or consists of a small irregular mass of renal tissue

Hypoplastic kidneys are subject to the same diseases found in normal kidneys and the symptoms are the same The diagnosis is made by cystoscopic and pyelographic studies The pyelogram shows a miniature of the normal renal pelvis or a dwarfed, deformed renal pelvis (Fig 31) The appearance time of injected dyes and the specific gravity of the urine from a hypoplastic kidney may be normal and, following a hastily made examination, the opposite kidney may be removed with the mistaken belief that a normal kidney remains The small amount of urine collected and quantitative estimation of dye excretion are of great importance in such cases The prompt appearance of concentrated dye is not sufficient evidence of a complete kidney unless a normal sized kidney has been demonstrated by pyelography or a well outlined renal shadow

The treatment of hypoplastic kidneys does not differ from that of normal kidneys except that nephrectomy should be done whenever surgical treatment is indicated The surgical treatment of the opposite kidney is the same as that of a solitary kidney

ECTOPIC KIDNEY

Ectopia of the kidney is one of the most frequent of renal anomalies One or both may fail to ascend to the normal location in the lumbar region Ectopic kidneys present special surgical problems because of the abnormal position and relationship of the kidney and because of the abnormal blood supply The blood vessels arise from and enter the nearest large vessel, usually the aorta and vena cava at a lower level than normal but in some cases the iliac vessels Accessory blood vessels are much more frequently encountered than in normally placed kidneys Ectopic kidneys are usually incompletely rotated so that the pelvis of the kidney occupies an anterior position rather than a mesial position These anatomical characteristics are important when approaching the kidney for surgical treatment (Fig 101)

Simple ectopia designates those cases in which one or both kidneys are arrested below the normal renal fossa In simple ectopia the kidney or kidneys remain on the same side of the body from which they had their embryonic origin (Fig 102) In most cases of simple ectopia one kidney is normally placed (Fig 103)

In crossed ectopia the nephrogenic mass of one side is deviated during embryonic life to the opposite side of the body and finally lies below the normally placed kidney Fusion of the kidneys is present in most cases of crossed ectopia, and the entire renal mass lies below the normal renal area In crossed ectopia the ureter of one kidney, usually the inferior one crosses over and enters the

Fig 101 —Ectopic kidney (Redrawn from Kelly and Burnham Diseases of the Kidneys, Ureters, and Bladder, D Appleton-Century Company, Inc)

Fig 102 —Pyelogram, right ectopic kidney

bladder on the opposite side of the body (Figs 29 and 104) This differentiates crossed ectopia clinically from unilateral double kidney with duplication of pelves and ureters In this anomaly both ureters enter the bladder on the same side

Fig 103 —Bilateral pyelogram right kidney ectopic calyces dilated

There are many variations of renal fusion, depending upon the portions of the kidneys that are joined together Almost without exception fused kidneys are also ectopic The most completely fused kidneys are the "cake" kidneys or

Fig 101.—Ectopic kidney (Redrawn from Kelly and Burnham Diseases of the Kidneys, Ureters, and Bladder, D Appleton-Century Company, Inc.)

Fig 102.—Pyelogram, right ectopic kidney.

ward The entire mass has an S shaped appearance Both the L shaped kidney and the sigmoid kidney are variations of the typical horseshoe kidney, which is the most common form of renal fusion Because of its relative frequency this anomaly is discussed at greater length than the other anomalies The surgical principles outlined for the treatment of horseshoe kidney can be applied to most cases of renal fusion With few exceptions ectopic and fused kidneys can be approached satisfactorily and more safely extraperitoneally than through the abdomen unless a tumor is to be removed (Fig 106) Exception to this may be made when the kidney occupies a position in the true pelvis

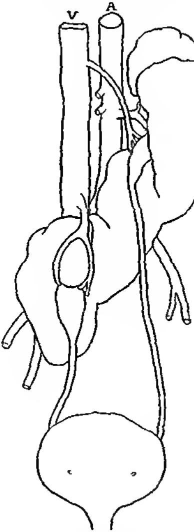

Fig 105 —Sigmoid kidney (Redrawn from Winternitz M C Johns Hopkins Hospital Bulletin 1908)

As previously mentioned, an important feature of these anomalies is the anomalous origin and number of the blood vessels and unless this is remembered large vessels may be injured while exposing the kidney In unilateral ectopia without fusion nephrectomy is advisable if the kidney is diseased, provided the opposite kidney is *normal* Drainage is usually inadequate and progressive degeneration of the kidney is the rule In fused kidneys it is often possible *to re*

"lump" kidneys in which the kidneys are fused along the entire external or mesial borders The renal mass is definitely larger than one kidney, lobulated and irregular in outline, and the pelves which remain distinct are situated anteriorly. Cake kidneys usually lie on one side of the body with one ureter entering the bladder on the opposite side or they occupy a position near the midline in the true pelvis.

Fig 104 —Pyleogram, crossed ectopia The normally placed kidney is incompletely rotated

Fusion most frequently occurs at the extremities of the kidneys, and in crossed ectopia it is usual for the upper pole of the ectopic kidney to be fused to the lower pole of the upper kidney, which in some cases occupies almost a normal position although complete rotation rarely occurs. Occasionally the ectopic kidney occupies a position across the spinal column almost at a right angle to the other kidney with fusion of the approximating poles. This anomaly is spoken of as an "L" kidney. The *sigmoid kidney* also lies across the midline of the body but at a less acute angle (Fig. 105). The upper pole is fused to the lower pole of the opposite kidney and the pelvis is directed downward and for-

the opposite side At operation an oblique incision was made and, when the peritoneum was reflected toward the midline, a swollen kidney studded with minute abscesses was exposed The upper pole was found attached by a narrow isthmus to the lower pole of the opposite kidney just above the bifurcation of the aorta (Fig 107) The isthmus was divided and the diseased kidney removed The patient made a satisfactory recovery

Fig 107—Sigmoid kidney fibrous attachment of upper pole of left kidney to lower pole of right kidney Lower kidney severely infected successfully removed extraperitoneally through Gibson incision

HORSESHOE KIDNEY

Surgical diseases of horseshoe kidneys are relatively frequent as compared with similar conditions in normally formed kidneys H S Jeck reported that twenty six horseshoe kidneys were found in 16,735 autopsies or one for each 632 cadavers, while there were four cases of horseshoe kidney in 400 operations upon the kidney He also found that the average age at death excluding deaths during the first year, was 43 years A K Thompson noted that the span of life in a group of necropsies he compiled was 35 years Other reports of necropsies vary from one in 700 to one in 1,000

move the diseased portion when indicated. Here again the blood supply is very important, for the same blood vessel may supply a portion or both renal segments and the ligation of such a vessel would seriously impair the normal portion of the kidney. Nephropexy is rarely possible in renal ectopia because of the length or origin of the renal vessels The diagnosis of renal anomaly is usually made by cystoscopy and the urogram (Figs 29, 102, 103, 104) The symptoms of disease in a fused or ectopic kidney differ very little if at all

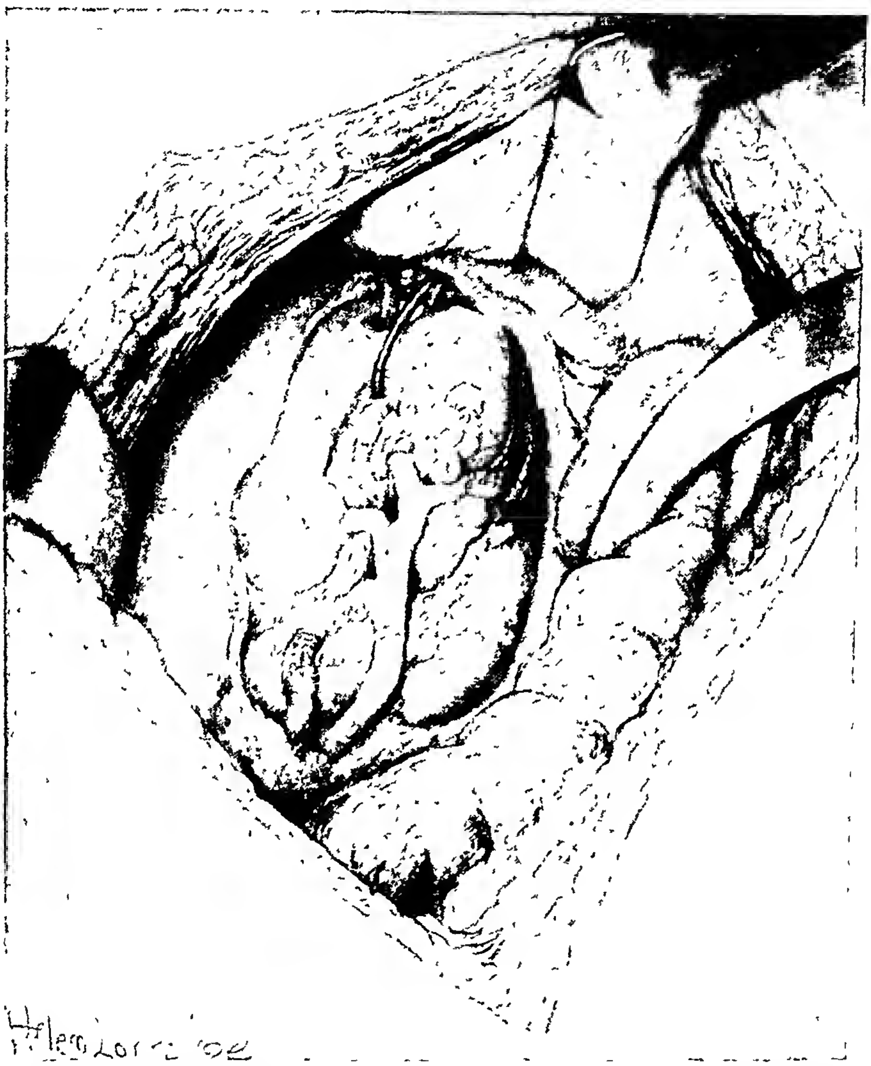

Fig 106—Extraperitoneal exposure of ectopic kidney Multiple blood vessels enter the kidney on the anterior surface and are easily exposed and ligated (See Fig 103 for pyelogram of this case)

from those of normally placed kidneys When a mass is felt in the lower abdomen, its true nature is rarely recognized preoperatively unless there are symptoms that suggest renal disease. A patient that I believed to have a stone in the lower third of the left ureter was found at operation to have a stone obstructing the pelvis of a sigmoid kidney. Because of complete obstruction to the passage of a catheter no pyelogram was made and lack of function from that side was attributed to the obstruction There was satisfactory function from

the opposite side At operation an oblique incision was made and, when the peritoneum was reflected toward the midline, a swollen kidney studded with minute abscesses was exposed The upper pole was found attached by a narrow isthmus to the lower pole of the opposite kidney just above the bifurcation of the aorta (Fig 107) The isthmus was divided and the diseased kidney removed The patient made a satisfactory recovery

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The abnormal anatomical arrangement, consisting of incomplete rotation of the kidneys and anomalies of the blood vessels and of the course of the ureters as they pass over the isthmus, interferes with adequate drainage (Fig. 108). Hydronephrosis is frequently encountered in such cases and infection is more difficult to eliminate. Both the poor drainage and the frequent infection encourage the formation of stones for which horseshoe kidneys are most frequently operated upon

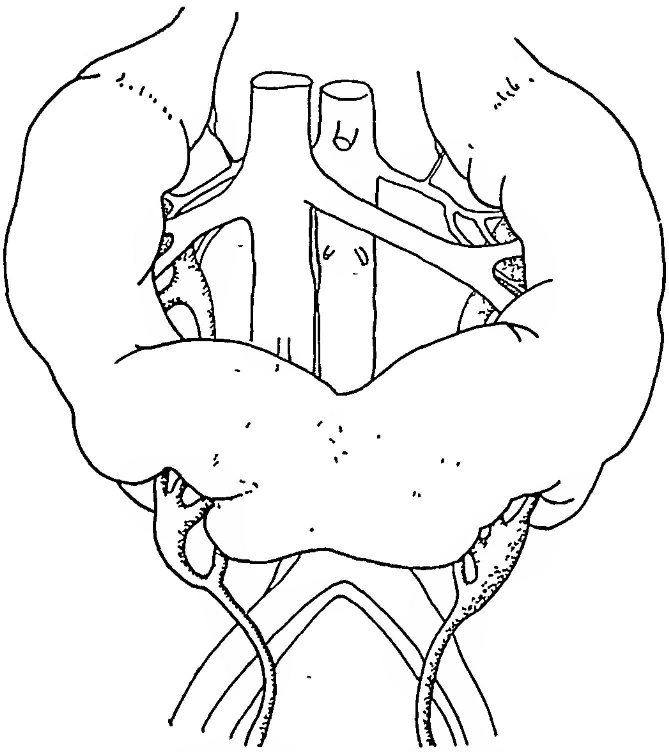

Fig 108 —Horseshoe kidney Four distinct kidneys, each with a separate pelvis (R B Oleson, Chicago) (Redrawn from Kelly and Burnham Diseases of the Kidneys, Ureters, and Bladder, D Appleton-Century Company, Inc) The ureters usually run over the anterior surface of the kidney

Diagnosis.—Gutierrez describes a "horseshoe kidney syndrome" characterized by pain in the epigastrium or umbilical region, sometimes radiating to the lumbar region, gastrointestinal disorders with chronic constipation from birth, and urinary disturbances He encountered these symptoms in 96 per cent of 25 carefully studied cases Abdominal pain is believed to result from pressure of the isthmus of the kidney on the splanchnic nerves. Extreme hyperextension is said to produce this pain or to increase it when already present. The diagnosis is usually made while investigating urinary symptoms, and in most cases by the appearance of the pyelogram. In very thin patients the isthmus can be palpated. The palpation of a kidney that is unusually low but not movable should lead one to suspect an anomaly. A plain x-ray film may show an outline of the kidneys in a lower and more mesial position than is normal and in some cases the isthmus can be recognized.

The pyelogram is quite characteristic. The pelves are elongated and irregular in outline and lie nearer the spinal column. The calyces are distorted and

those of the lower pole are inverted The ureters enter the pelves at a higher level than in normal kidneys and are farther apart as they enter the pelves (Fig 30) Bilateral pyelograms are important in making an accurate diagnosis of the contour and position of the kidneys and in determining the necessary treatment Intravenous pyelograms give an excellent picture of the anomaly when both kidneys are functioning sufficiently In other cases retrograde pyelography must be resorted to When interpreting the pyelogram particular attention should be given to the downward and inward course of the lower calyces (Fig 30) Gutierrez has described a triangle as diagnostic in these

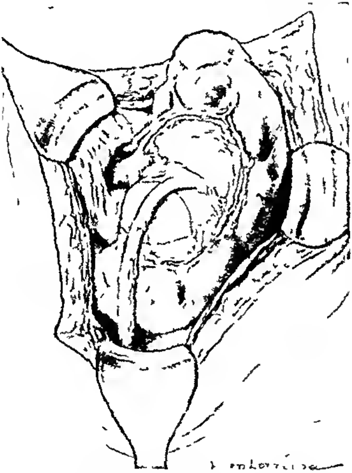

Fig 109 —Plastic operation on dilated pelvis of horseshoe kidney to improve drainage Dotted line indicates portion of pelvis to be excised There was a stone in the pelvis

cases The triangle consists of a line connecting the tips of the two lowest calyces and lines drawn from the extremities of this line to the midpoint of a line connecting the two iliac crests The angle formed at the base line is approximately 20 degrees in horseshoe kidneys and averages 90 degrees in normal kidneys Differential function and other laboratory tests are as important here as in other cases of surgery upon the kidney

Surgery of the Horseshoe Kidney—Pyelotomy for the removal of stone, plastic operations on the pelvis and ureter for improvement in drainage

(Figs 109 and 110), nephrectomy for tumor or destruction of the kidney by hydronephrosis, infection, or stone, and division of the isthmus for the relief of pain or the improvement of drainage may be required. An oblique lumbar incision extending further anteriorly than in the usual kidney operation gives satisfactory exposure. The anterior extension of the incision is necessary for exposure of the isthmus. After the incision has been carried through the muscles and the transversalis fascia, Gerota's fascia is freed posteriorly and above and divided opposite the posterior lip of the renal sinus. It is then separated from the kidney with the perirenal fat and retracted toward the midline, exposing

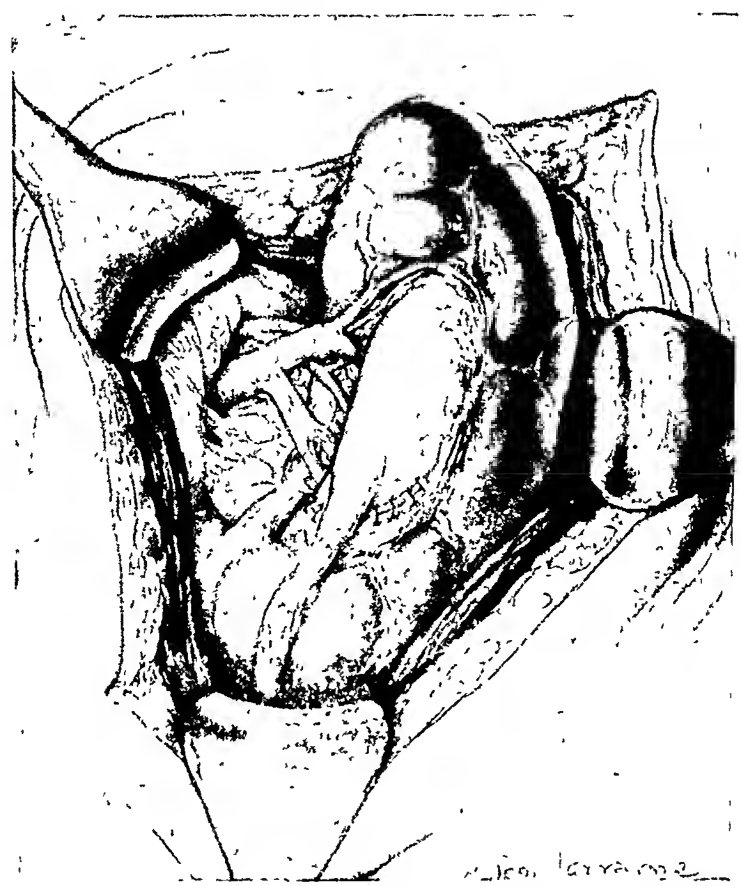

Fig 110—Section of pelvic wall has been removed and the wound closed, thereby bringing ureteropelvic orifice to most dependent portion of the pelvis

the kidney and its pedicle. The peritoneum is retracted with the perirenal fascia and fat and thereby protected. The main vascular supply of the kidney usually enters above and behind the pelvis. The pelvis lying anteriorly is more easily approached from its anterior surface The lower pole of the kidney is fixed in position by the isthmus. In this area a number of anomalous blood vessels usually enter the kidney. It may be necessary to divide some of them before complete mobilization can be obtained. The division of large vessels is undesirable unless nephrectomy is necessary. If nephrectomy is to be done it is more satisfactory to ligate and divide the main pedicle first; then by gentle traction on the kidney the lower pole and the isthmus can be more easily exposed and liberated.

In all conservative operations upon a horseshoe kidney it is desirable to divide the isthmus It often produces pain and probably gastrointestinal symptoms by pressure on the great vessels and splanchnic nerves and it interferes with adequate renal drainage Frequently the isthmus consists of little more than fibrous tissue and usually when it is composed of renal tissue there is a constriction at the midpoint which clearly indicates the proper location for division When such a constriction is not present, careful examination of the pyelogram should be made to prevent dividing a lower calyx

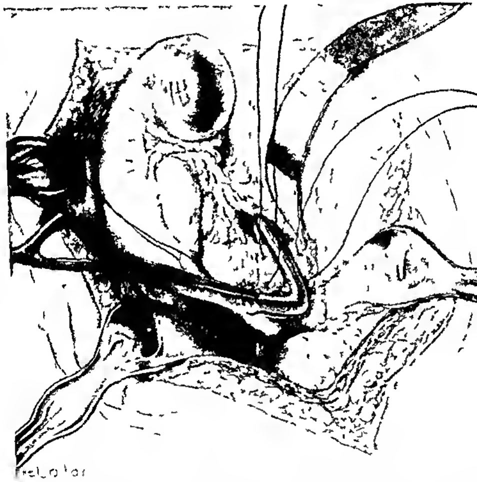

Fig 111 —Dividing the isthmus of a horseshoe kidney as described by Baker and Colston The isthmus is grasped and crushed by a heavy right angled clamp Mattress sutures are placed and tied on both sides of the clamp The clamp is then removed and the isthmus divided between the ligatures

When the isthmus is to be divided, it is carefully liberated sufficiently beyond the midline to permit accurate closure of the distal stump This is easily accomplished by making gentle traction forward and outward on the lower pole of the kidney as adhesions are stripped from the isthmus A right angled clamp applied to the isthmus at the line chosen for division will aid in the control of bleeding serve as a tractor to pull the distal portion of the isthmus into the wound, and at the same time promote hemostasis by crushing the tissues Mattress sutures are placed through the isthmus about half an inch from

the clamp on either side and tied snugly over fat to prevent cutting into the renal tissue (Fig 111) The isthmus is divided along the proximal margin of the clamp and the clamp is left attached to the distal stump while the proximal stump is carefully examined and further sutures are applied, if necessary, to control bleeding. The clamp is then removed and the other stump is treated in like manner. If available, tags of fat are sutured over the stumps The kidney of the opposite side is now permitted to retract to its normal position and attention is given to the kidney which has been exposed. As previously mentioned, the pelvis is more easily approached anteriorly for the removal of stones

Fig 112—Dilated left pelvis of horseshoe kidney twelve months following plastic operation (Figs 109 and 110) There was a recurrence of stone

or for plastic procedures upon the pelvis and ureteropelvic junction. When the pelvis has been opened, it should be drained by a nephrostomy tube and closed as accurately as possible The leakage of urine will cause dense adhesions to the peritoneum which lies very close to the pelvis of a horseshoe kidney. In the event of a second operation such adhesions are troublesome In a case of mine, while operating upon such a kidney for the recurrence of stones and attempting to free the peritoneum from the pelvis, a large vein near the lower pole was injured. This necessitated resection of the lower pole of the kidney, including a portion of the isthmus (Figs 112, 113, 114, 115, 116, and 117) Fortunately

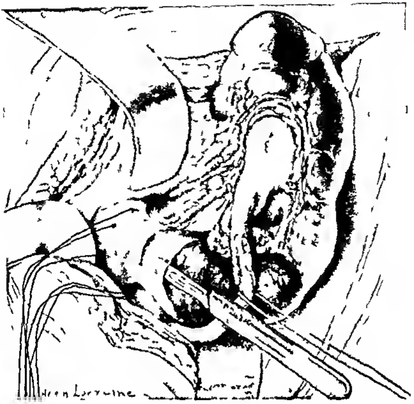

Fig 113 —Injury of a large vein when attempting to expose the renal pelvis made it necessary to resect the kidney from the lower margin of the pelvis to the isthmus note cyanotic area and interrupted sutures placed to right of isthmus preparatory to closing right stump when isthmus is divided

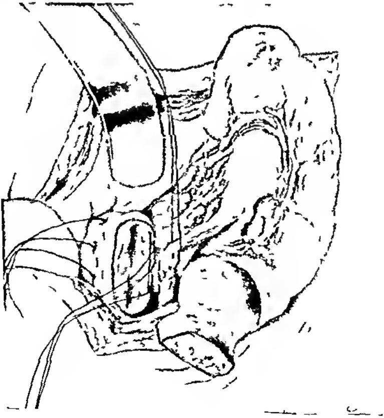

Fig 114 —The isthmus has been divided

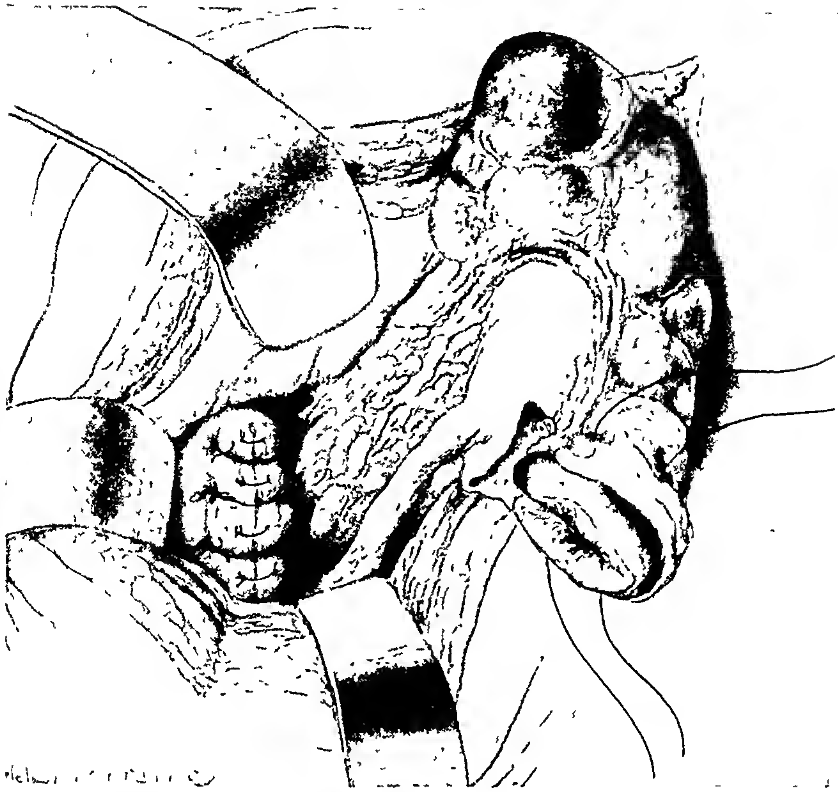

Fig 115 —The ligatures to the right of the isthmus have been tied and the renal capsule has been closed over the stump with interrupted sutures On the left side the lower pole of the kidney has been excised and sutures are placed to close the incision

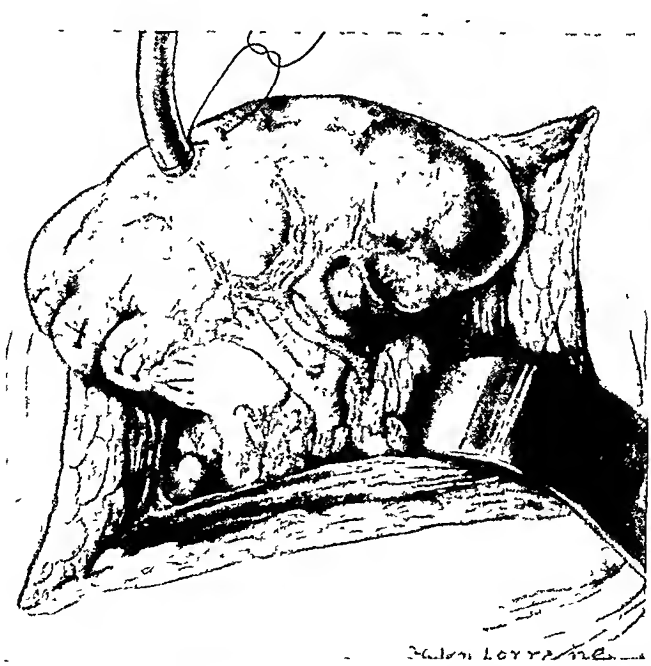

Fig 116 —The operation is completed by placing a nephrostomy tube for drainage, closing the pelvis, and suturing the capsule over the lower pole of the kidney

this resection permitted excellent drainage and the function of the kidney was decidedly improved Most surgeons who have had experience with horseshoe kidneys advise that division of the isthmus be followed by nephropexy This serves to straighten the course of the ureter and so improves the drainage

A very satisfactory type of nephropexy for these cases is that described by Kelly (pp 212 216) Two sutures are sufficient One is placed through the capsule of the kidney opposite the pelvis to be brought out above the twelfth rib or through the costovertebral ligament and the other is placed near the lower pole of the kidney, to be sutured to the quadratus lumborum muscle When these

Fig 117 —Pyelogram taken following recovery from operation (Figs 113 to 116) There has been an improvement in drainage and a reduction in size of the pelvis since the isthmus was divided (See Fig 112)

sutures are tied the kidney is held upward and the lower pole outward, thereby improving drainage by causing the ureter to follow a more direct course Rubber tissue or rubber covered gauze drains are placed down to the stumps of the severed isthmus and brought out near the upper angle of the wound If a nephrostomy tube has been used, it is brought through the wound in as straight a line as possible The reflected fat and fascia are then replaced and sutured to the psoas muscle below the kidney and to the quadratus lumborum posteriorly This protects the kidney from adhesions to the wound and aids in holding it in place The wound is closed in layers as described in Chapter V

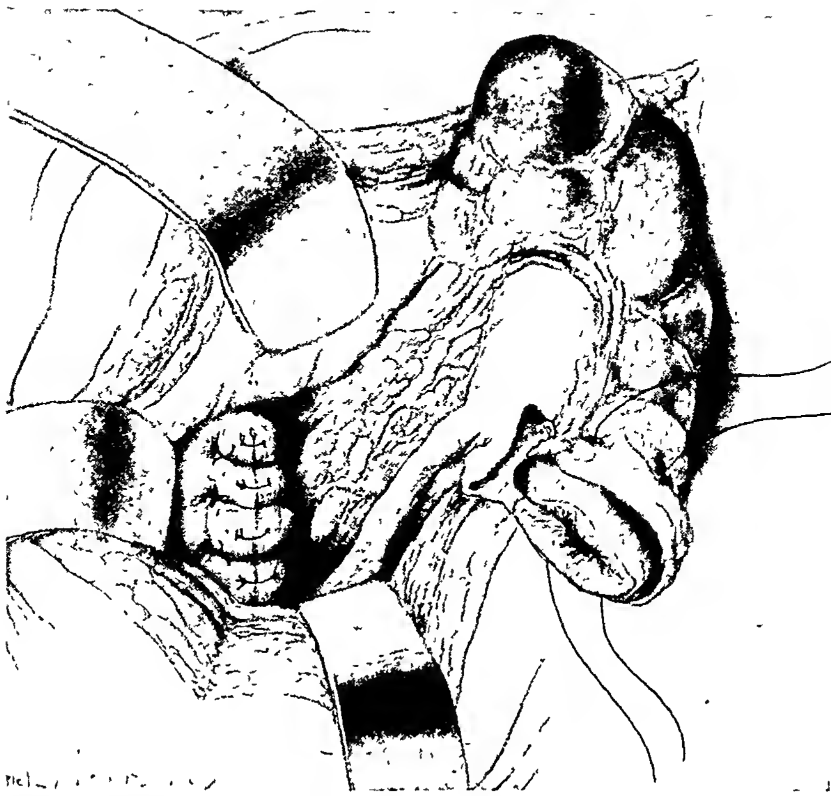

Fig 115 —The ligatures to the right of the isthmus have been tied and the re capsule has been closed over the stump with interrupted sutures On the left side the lo pole of the kidney has been excised and sutures are placed to close the incision

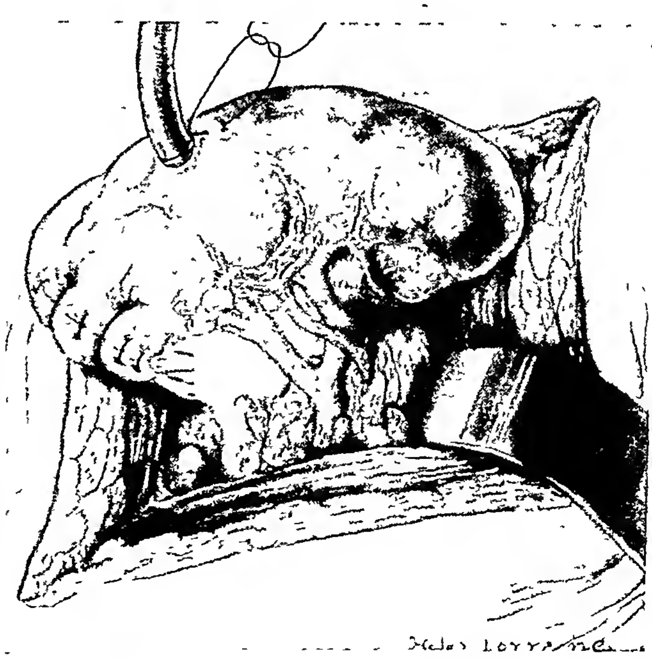

Fig. 116 —The operation is completed by placing a nephrostomy tube for drainage, closing t pelvis, and suturing the capsule over the lower pole of the kidney

CHAPTER VII

THE SURGICAL TREATMENT OF RENAL INFECTIONS

Pyelonephritis, Infections of the Renal Cortex, Perirenal Abscess, Nephrostomy

The surgical treatment of renal infections consists principally of the correction of obstructive processes, drainage of the kidney and perirenal space and nephrectomy. The treatment of obstructive lesions including renal and ureteral calculi are discussed in chapters devoted to these subjects. We are concerned here principally with those cases in which the infection is, so far as can be determined, the primary lesion. Infections may approach the kidney through either the pelvis or the cortex. The infection may become more or less localized causing pyelitis or cortical abscess, but in either case it may spread to involve the entire organ. The use of modern chemotherapy and antibiotics has greatly reduced the need of surgery in the treatment of renal infections.

PYELONEPHRITIS

Infections arising in the pelvis are more frequently encountered, are often bilateral, and less destructive unless complicated by obstruction. The infecting organism is usually the colon bacillus and cases that are not complicated by stone or obstruction rarely require surgical treatment. Acute pyelonephritis occasionally progresses so rapidly and causes such toxic manifestations that nephrectomy or decapsulation and nephrostomy are necessary as a lifesaving measure. Fortunately such fulminating cases are usually unilateral. They may follow acute obstruction or trauma, such as a stone blocking an infected kidney, pyelography with overdistention of the pelvis, ureteral manipulations for the removal of a stone in the presence of infection, or operations upon the kidney. I recall a very unfortunate incident in which a stone was removed from the lower calyx of an infected kidney with considerable difficulty and trauma to the kidney. Within a week the kidney was removed, because of chills, fever and toxic symptoms. The kidney was a mass of small abscesses. Within a week a severe infection occurred in the remaining kidney and the patient died.

The clinical manifestations of such cases are those of severe septicemia. The fever is constantly high or varies from normal to 104° or 105° F, the pulse is rapid, chills with sweats are not unusual. There is abdominal distention with vomiting of foul smelling black material. The patient is acutely sensitive in the loin on the diseased side and the muscles overlying the kidney are spastic. There is a leukocytosis, and a cystoscopic examination will show the function of the diseased kidney to be nil or greatly diminished.

At operation the perirenal fat is edematous and the enlarged, congested kidney is dotted with small pustules. These suppurative foci may be confined

Operative Hazards.—*Mention has been made of the frequency of anomalous blood vessels in horseshoe kidneys* Dissection about the lower pole and the isthmus should proceed cautiously because of the danger of injuring these vessels The veins are thin-walled and easily torn. Before clamping a larger vessel its circulation should be interrupted by gentle pressure for a few minutes to determine the location and amount of kidney tissue that may be affected. Rarely the isthmus lies behind or between the aorta and vena cava. This should be determined before attempting to free the isthmus A small percentage of horseshoe kidneys are connected at the upper poles This departure from the usual attachment should be recognized during the preoperative examination and the operation planned accordingly. In this anomaly the adrenal glands are said occasionally to be fused. Such possibility should be remembered when nephrectomy is necessary.

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lumbar area and along the course of the ureter, either as a constant ache or in repeated attacks Some patients have repeated attacks of acute pyelitis, but in some cases there is no pain, and the condition of the kidney is recognized while seeking the source of persistent pyuria The pyelogram in such kidneys is distorted, with blunting of the calyces and often some dilatation of the pelvis If the outline of the kidney can be seen the calyces will often appear to extend almost to the cortical surface (Fig 119) The ureter may present areas of constriction and dilatation The size of these kidneys varies from normal to less than a third the size of the average kidney

Fig 119—Pyelogram of chronic pyelonephritis Compare dilated calyces with those of the normal right kidney

At operation the perirenal fat is infiltrated by fibrous strands and is densely adherent to the kidney About the hilum the fat is often particularly dense and the pedicle is difficult to expose *On section the cortex is thin and contains numerous cicatricial areas There may be small abscesses near the calyces* Frequently the peripelvic tissue is *largely replaced by fat Braasch has de-*

to limited areas of the kidney or may dot the entire renal surface. The operative procedure varies according to the condition of the patient and the extent of renal damage. Keyes has called attention to the fact that these fulminating infections usually subside following nephrostomy and stripping the renal capsule. This is certainly true when obstruction is a causative factor. A patient that I treated by nephrostomy and decapsulation recovered but had recurrent attacks of acute pyelitis and eventually developed a hypertension which was cured by removing the diseased kidney (Fig 118) If the patient is profoundly toxic and the opposite kidney normal, nephrectomy is the safer procedure.

Fig 118 —Chronic pyelonephritis Note thinning of cortex, infiltration of fat, and thickened walls of arterioles This patient had hypertension which was relieved by nephrectomy

Chronic pyelonephritis is frequently associated with stone or obstructive lesions of the urinary tract. In such cases the infection is usually secondary to the obstruction and if not too far advanced will subside when the obstruction is relieved. The surgical treatment of these diseases, including drainage, is discussed in appropriate chapters.

Occasionally chronic pyelonephritis progresses to renal destruction or is accompanied by pain or hematuria to the extent that nephrectomy is advisable, provided the condition is unilateral or is much more advanced in one kidney The infection is usually complicated by some obstructive lesion, such as a stricture or kink of the ureter, although cases are reported in which no obstructive lesion can be recognized The patient is usually below par in general health and there is often a moderate degree of anemia. Pain is complained of in the

scribed an atrophic form of pyelonephritis which he considers to be probably the end result of septic infarcts The kidney is greatly reduced in size and densely adherent, the renal pelvis is thick and fibrotic, and the renal cortex is irregular and shows many pale areas of cicatricial degeneration (Fig 120)

In some cases there is pronounced renal arteriosclerosis These patients frequently suffer from hypertension, and, if the condition is unilateral, nephrectomy may give relief (Fig 121)

INFECTION OF THE RENAL CORTEX

Primary infection of the renal cortex is less frequently encountered than infection beginning in the renal pelvis The bacteria are usually staphylococci and reach the kidney through the blood stream from a primary, suppurating

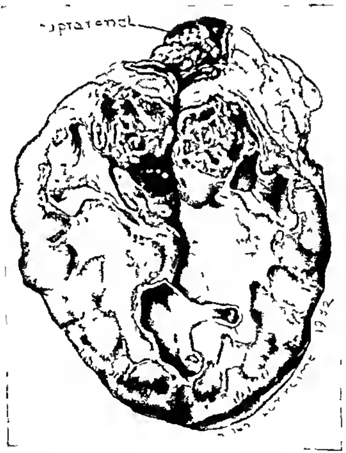

Fig 122 —Abscess in upper pole of chronically infected kidney Note keratosis of middle calyx

focus, often involving the skin, although the disease may be caused by suppuration in other organs In my own practice such infection has followed the scratch marks in a case of scabies, carbuncles of the skin, paronychia, osteomyelitis and stitch abscess Respiratory infection has been recorded as the probable cause in a few cases In most cases only one kidney is involved but

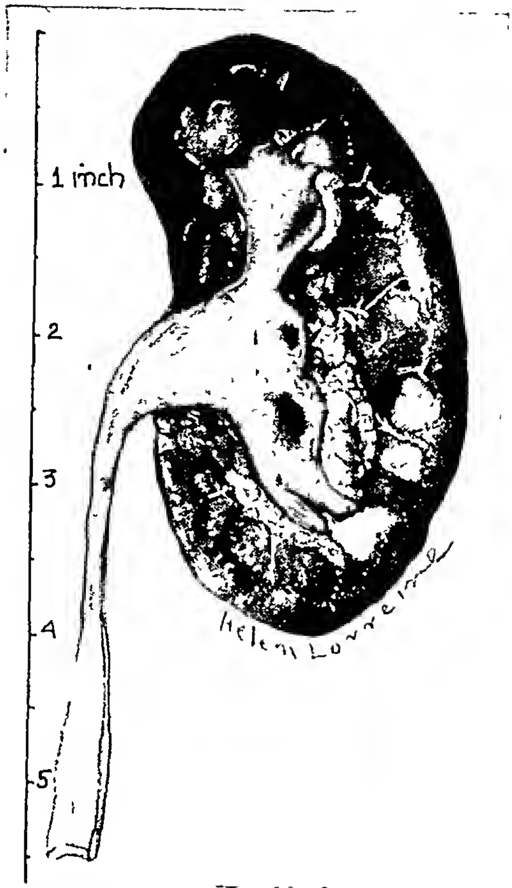

Fig 120—Chronic atrophic pyelonephritis Note loss of normal renal markings, reduction in size of the kidney, and excessive amount of fat around the pelvis The kidney was ptosed, with greatly reduced function Patient had constant pain

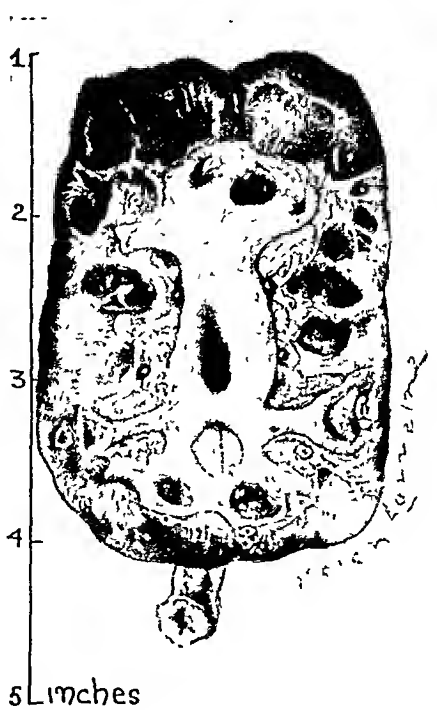

Fig 121—Atrophic arteriosclerotic kidney removed from a child ten years of age The child was referred for urological consultation because of hypertension blood pressure, systolic 240, diastolic 170 Average blood pressure two years postoperative systolic 160, diastolic 120

abscess The primary source of the perinephric suppuration is not often recognized The renal carbuncle seems to progress more slowly and even though an extensive area of the kidney is involved perirenal suppuration is, as a rule, not very extensive

Early symptoms of renal cortical infection are often confusing and it is difficult to arrive at an early diagnosis At first the pain is not well localized and may suggest infection of the appendix or gall bladder When the infection is in the upper pole of the kidney there may be a preliminary diagnosis of pleurisy or pneumonia The illness frequently begins with a chill and the continued prostration, malaise and fever resemble a blood stream infection The blood count shows an increase in leukocytes, often fifteen to twenty thousand Urinary symptoms are rarely present The urine is often negative, although a few red blood cells and pus cells are found in some cases A patient that I treated had an intermittent pyuria At operation a carbuncle of the upper pole of the kidney communicated with the upper calyx by a minute opening The carbuncle in this case was on the anterior surface of the upper pole of the kidney and there was a mild jaundice which caused considerable delay in the diagnosis

Almost without exception tenderness will be found in the region of the kidney and in most cases there is rigidity of the muscles overlying the kidney The rigidity may be barely perceptible but when compared with the opposite side it can be recognized With the patient in the prone position, slight fullness can be noted in the costovertebral angle as compared with the opposite side In thin patients there may be a palpable enlargement of the kidney A visible mass in the flank is rarely found unless there is also a perirenal abscess

Cystoscopic examination is frequently helpful but rarely conclusive In carbuncle of the kidney there may be diminished renal function as compared with the opposite kidney, or evidence of renal infection If the outline of the kidney can be clearly seen, there may be some irregularity or enlargement of the shadow Distortion of the calyx nearest the carbuncle is a frequent finding In cases of simple cortical abscess the renal shadow and pyelogram are usually entirely normal Obliteration of the psoas muscle shadow is suggestive of perirenal suppuration

A careful history is the most valuable single diagnostic procedure Such a large percentage of patients with abscess or carbuncle of the renal cortex give a history of a previous suppurative process usually on the skin that a patient with tenderness over the kidney, fever and a leukocytosis should be carefully questioned for evidence of such infection Sometimes the primary infection, a paronychia or small boil, was so insignificant that it has been forgotten The renal infection may occur before the primary lesion has healed or several months may elapse before there is evidence of renal infection In a series of cases reported by Graves and Parkins, there was an average of fifty three days between the original infection and the onset of illness from renal infection

The treatment is always surgical when suppuration had occurred Simple cortical abscess of the kidney will heal promptly following adequate drainage in fact, the majority rupture producing a perirenal abscess which is drained,

bilateral infection is occasionally reported. I have encountered bilateral cortical abscesses in four patients, three of whom recovered. One of these also developed an abscess in the prostate.

The pathology consists of a single area or of multiple areas of suppuration in the cortex of the kidney. If the suppurating foci are numerous, the disease may follow a fulminating course similar to the severe cases of acute pyelonephritis. Such severe cases usually occur in staphylococcic septicemia and are not often recognized clinically. As a rule the suppurating foci involve only a small

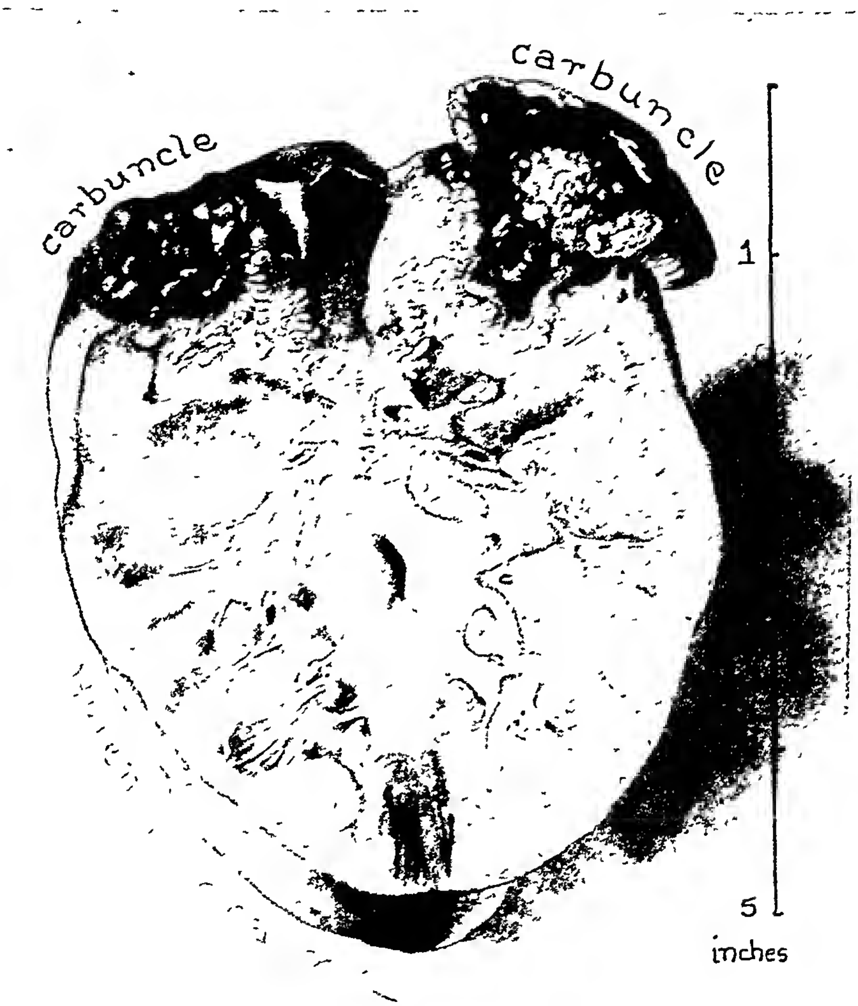

Fig. 123.—Carbuncle involving the upper pole of the kidney.

area of the kidney and pursue a much milder course. The lesion may be a solitary abscess situated near the surface of the kidney or it may be a circumscribed multilocular abscess (carbuncle), involving a limited or an extensive area of the kidney. Both of these lesions eventually rupture on the surface of the kidney, producing perirenal suppuration (Figs. 122 and 123).

Clinically it is rarely possible to differentiate cortical abscess from carbuncle of the kidney. The difference is chiefly one of degree. Cortical abscess is not so frequently seen; probably it ruptures relatively early and causes a perinephric

spasm on the infected side. Within a few days such an abscess may occupy most of the retroperitoneal space, from the true pelvis to the diaphragm, and the condition will terminate fatally if early drainage is not instituted. More frequently a perirenal abscess pursues a subacute or chronic course, often existing for weeks before it is recognized and treated. When the infection in the kidney progresses slowly, there is time for perirenal adhesions to occur and as the disease progresses toward the renal surface, the perirenal fat and fascia become sclerotic, forming to some extent a barrier to the extensive spread of perirenal suppuration.

The clinical symptoms of perinephritic abscess are very similar to those of cortical abscesses and carbuncles of the kidney, and well they may be, since perinephritic abscess is often a complication or a progression of the same pathological process. Perinephritic abscess is characterized by leukocytosis, costovertebral tenderness, muscle spasm over the renal area, and frequently by the appearance of fullness or a mass in the costovertebral angle. If the disease is of long standing there is flexion of the thigh on the affected side because of irritation of the psoas muscle.

The history or examination will often reveal the source of infection to be a boil, a carbuncle or an infected wound. In some cases there is a history of prolonged renal infection.

X ray examination will usually show diminished excursion of the kidney on inspiration and expiration, scoliosis (with convexity of the spine away from the abscess) and obliteration of the psoas muscle shadow.

Bladder symptoms are unusual and the urine may be free from pus unless there is infection of the renal pelvis. The greatest value of a cystoscopic study is in determining the condition of the kidney and in differentiating intrarenal from extrarenal pathology. If the pelvis of the kidney communicates with the perirenal space it will be demonstrated by the pyelogram. Distortion or obliteration of one or more calyces indicates cortical suppuration as a predisposing factor. In some cases the position of the kidney and upper third of the ureter may be distorted by pressure of the abscess. It is not always possible to differentiate perirenal abscess from cortical infection of the kidney. In most cases the history is similar and an intermittent fever, leukocytosis and absence of pyuria are the rule in both diseases. On an average there is greater muscle rigidity in perirenal abscess, and often a fixed mass in the flank. The kidney is often palpable in cortical abscess. Obliteration of the psoas shadow and limitation of renal motion is not a feature of cortical infection.

The treatment is surgical in all cases. Preoperative knowledge of the condition of both kidneys is very helpful in determining the extent of the surgical procedure. Usually thorough drainage of the infected perirenal space is all that is necessary. An incision about half the length of the regular lumbar incision is usually sufficient. It is rarely necessary to incise the oblique abdominal muscles unless the kidney is to be removed. A careful preoperative study of the kidneys is very helpful in determining the extent of the operation.

Occasionally a nephrectomy or nephrostomy should be done in the presence of a perinephritic abscess. When an abscess is caused by a large renal car

and the patient is cured with no direct attention to the renal infection. On two occasions I have exposed a solitary abscess of the kidney before rupture occurred. The abscess in each case was on the convex border of the kidney Perirenal fat was densely adherent to the area and when it was separated from the kidney the abscess was opened The pus was aspirated, leaving a smooth conical cavity in the renal cortex. The cavity was lightly packed with gauze which was brought with rubber tissue perirenal drainage through the upper angle of the lumbar wound. There was a moderate amount of suppuration in the drainage tract but the wound healed rapidly in both patients

Carbuncle of the kidney unless bilateral usually requires nephrectomy (Fig. 123). If the lesion is small and confined to one pole of the kidney, excision through healthy tissue will result in a cure without the sacrifice of the entire kidney. Occasionally the carbuncle is clearly localized and a line of cleavage can be found and the diseased tissue enucleated Opportunities for these conservative operations are rarely encountered The carbuncle usually involves a considerable portion of the kidney with evidence of infection extending well beyond the suppurating area. If the opposite kidney is normal, nephrectomy offers the quickest and surest means of cure. Drainage of a carbuncle is an unwise procedure except in cases of necessity. The multilocular character of the lesion makes it very difficult to drain all the abscess pockets, and the infection may continue to spread while drainage is in progress. In the series of case histories studied by Graves and Parkins, the mortality was highest in those patients treated by drainage

PERIRENAL ABSCESS

True perirenal abscess or abscess arising within the perirenal fascia is probably always caused by renal infection, most frequently suppurative lesions in the cortex, and occasionally the rupture of a pyonephrotic or infected, hydronephrotic kidney. Some authors contend that perirenal abscess may have its origin from metastatic foci directly to the perirenal tissues (Fig. 55) While this source of infection cannot be denied, it is probably a rare occurrence. Occasionally there is a history of trauma to the renal area. Perirenal abscess quite commonly occurs when a ruptured kidney is not operated upon immediately.

Abscesses involving the space external to the perirenal fascia, sometimes spoken of as pararenal infections, are extrarenal in origin. The most frequent sources are a ruptured retrocecal appendix, caries of the spine and suppurative diseases in the thorax. Clinically it is usually impossible to differentiate perirenal abscess from pararenal abscess

The pathology and clinical course of perinephritic abscess differ markedly in different cases When the renal infection causing the abscess progresses rapidly or when the abscess follows the rupture of an infected kidney, perirenal suppuration is extensive and runs a rapid course The patient is extremely ill with chills, intermittent fever, abdominal distention, and extensive muscle

spasm on the infected side. Within a few days such an abscess may occupy most of the retroperitoneal space, from the true pelvis to the diaphragm, and the condition will terminate fatally if early drainage is not instituted. More frequently a perirenal abscess pursues a subacute or chronic course, often existing for weeks before it is recognized and treated. When the infection in the kidney progresses slowly, there is time for perirenal adhesions to occur and as the disease progresses toward the renal surface, the perirenal fat and fascia become sclerotic, forming to some extent a barrier to the extensive spread of perirenal suppuration.

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buncle very little improvement follows simple drainage, and in most cases a secondary nephrectomy is necessary in a patient further weakened by continued sepsis. A primary nephrectomy under such conditions is less difficult and should be done in most cases. I have encountered a few patients with pyonephrosis of long standing, with a perinephritic abscess, in which a subcapsular nephrectomy was successfully accomplished at the same time the perirenal abscess was drained When an abscess is caused by rupture of a pyonephrotic kidney containing an obstructing stone, the thinned cortex of the kidney should be incised and the stone removed if it is possible to do so. Thorough drainage of the renal and perirenal cavities completes the operation. The re-establishment of ureteral drainage may obviate the necessity of a secondary nephrectomy.

If no operation upon the kidney is indicated, the abscess cavity should be thoroughly explored with the finger and any accessory pockets opened up It is unnecessary to expose the kidney thoroughly unless there is cystoscopic evidence of renal pathology. The abscess cavity should be well drained The wound should be only partly closed, leaving adequate space for the drainage tubes

NEPHROSTOMY

Adequate drainage is the most important single factor in controlling infection and in preserving and improving renal function. Nephrostomy is done (1) to relieve the patient of overwhelming sepsis and permit him to reach a physical state in which corrective urological procedures can be instituted, (2) to drain the kidney during a period of repair following an operation; (3) to remove stones or to correct obstructive lesions, (4) to conserve and permit physiological restoration of renal tissue impaired by obstructive disease processes, and (5) to provide permanent drainage when the ureter can no longer function.

The decision to do a primary nephrectomy or a nephrostomy for pyonephrosis depends upon a number of factors, not the least of which is the skill and dexterity of the surgeon In a patient with a large, pyonephrotic kidney who has become greatly debilitated because of sepsis, nephrectomy is a hazardous procedure, especially if the operation cannot be done quickly and without undue trauma The danger is further increased in the aged and when the opposite kidney is impaired In this small group of cases nephrostomy is often a lifesaving operation. A preliminary nephrostomy increases the density of perirenal adhesions but the decrease in the size of the kidney and the improvement in the patient's resistance often more than compensate for the added difficulty in freeing the kidney. The circumstances under which the patient is operated upon also may influence the method of operating. A much more radical operation can be undertaken in a well-equipped hospital with facilities available for any contingency than would be advisable in less favorable surroundings Blood transfusions, the continuous administration of dextrose solution and the administration of oxygen often turn the tide following extensive surgical procedures. There remains an occasional patient, emaciated and septic, often

advanced in years, with a tremendous pyonephrosis pressing against the diaphragm and extending well into the abdomen Nephrostomy and active supportive treatment will often restore such a patient to health Primary nephrectomy in this group cannot be justified

Severe acute infections of the kidney occasionally do not respond to internal medication or to catheter drainage and in some cases complicated by obstruction a catheter cannot be inserted These patients often respond well to nephrostomy and decapsulation The infection rapidly subsides and normal function is restored Nephrectomy is rarely necessary in acute renal infections

In acute renal obstruction especially when there is anuria, nephrostomy is often the safest procedure The tube can be accurately placed and adequate drainage is assured The procedure is frequently resorted to when the ureters have been injured or tied and when a stone obstructing the ureteropelvic area has caused dilatation or infection of the kidney When the stone is located lower in the ureter it is usually removed and the ureter drained If there are stones in the kidney above the obstructed ureter, it is more satisfactory to remove the renal stones and drain the kidney The ureteral stone will often pass during the nephrostomy drainage

The kidney should be drained in all cases following plastic operations on the kidney pelves and upper ureter, and when stones are removed from a dilated or infected kidney, nephrostomy is much more satisfactory than pyelostomy even when only the pelvis is involved in the operation The drainage tube can be placed so that it leads directly to the surface, is easily kept in place, and after a few days can be removed and replaced without difficulty A tube inserted through the cortex does not cause noticeable destruction of renal parenchyma and, when used in an unobstructed kidney, prompt healing takes place when the tube is removed regardless of the length of time it has been in place A drainage tube inserted through the kidney pelvis is more difficult to keep in place and impossible to reinsert when it becomes dislodged It increases adhesions to the pelvis which may later interfere with satisfactory kidney drainage and if the tube remains for an extended period a fistula may persist

It is difficult always to determine accurately the functional possibilities of a kidney previous to operation A kidney impaired by obstruction and infection will often show remarkable improvement following the institution of drainage This is notably true in cases of renal calculi A conservative operation is justified when the kidney seems in fair condition even though the recorded function is poor Joly is very pessimistic about the results of conservative operations on kidneys infected with alkaline producing organisms He believes that the destruction of the kidney will be progressive that stones, if present, will frequently return and that there is danger of infecting the other kidney It is difficult to formulate a general rule for all such cases Nephrectomy should be done when the opposite kidney is free from infection and shows evidence by functional tests of compensatory hypertrophy, otherwise the stones should be removed and the kidney drained With the aid of present day chemotherapy and antibiotics, the outlook in these severely infected kidneys is more favorable, and

nephrostomy drainage should be continued until the purpose for which it was done has been accomplished. The tube should not be removed until the kidney has recovered its maximum function and can drain satisfactorily through normal channels, or until a more satisfactory method of drainage has been established. Nephrostomy drainage following the removal of a stone from a kidney with good function may be discontinued after a few days. When a plastic operation has been done on the kidney pelvis, drainage should be continued until the kidney pelvis and ureter have proved capable of resuming function When a badly diseased kidney must be retained, prolonged drainage is necessary.

When nephrostomy is done as an emergency operation following injury or occlusion of the lower ureter, or as a means of conserving and improving renal function when the ureter is occluded by disease, permanent drainage may be later established by transplanting the ureter into the bladder or sigmoid.

When pathological conditions of the bladder or terminal portion of the ureter require diversion of the urine, the ureter is usually transplanted to the sigmoid or to the skin of the abdomen. Transplantation to the sigmoid is more satisfactory when the ureter is healthy and the kidney is free of infection. In cases not suitable for transplantation to the sigmoid a drainage orifice on the abdomen is more accessible and more easily cared for by the patient than nephrostomy drainage. When the function of the ureter is destroyed or the renal pelvis is hopelessly obstructed, permanent nephrostomy will prolong life and add greatly to the comfort of the patient. Patients with large, branching, and obstructing calculi which cannot be safely removed, or with neuromuscular dysfunction of the kidney pelvis and ureter, or with pyonephrosis of an only kidney, either pyogenic or tuberculous, are often greatly benefited by nephrostomy.

Nephrostomy Technique

Nephrostomy, when done preliminary to nephrectomy, is usually a very simple procedure The kidney is greatly enlarged and is easily exposed In most cases the operation can be done under local anesthesia, which should be used whenever possible in aged and very ill patients. The incision should be just long enough to permit sufficient exposure to establish drainage of the kidney. It should preferably occupy the middle half of the incision to be used later for nephrectomy. When the anterior fibers of the latissimus dorsi have been cut and the transversalis fascia has been opened, the convex border of the enlarged and distended kidney presents in the wound. The kidney will usually be exposed over the lower third. The perirenal fat and fascia are often densely adherent to the kidney. There is no advantage in attempting to strip them off. The kidney mass is separated just enough to permit an incision through the cortex. The incision is made through a fluctuant area if it can be felt. Before incising the kidney, the surface of the wound is protected with gauze, and a suction tube should be used when available to limit contamination of the wound as much as possible. When the purulent material has drained away, the finger is inserted to explore the cavity and break up isolated pockets. Any accessible stones are removed. A large tube is placed in the center of the cavity for drainage and

adequate drainage tubing is placed down to the surface of the kidney. The wound is closed loosely around the tubes with interrupted sutures of silkworm gut. Drainage tubes should not be sutured to the skin because of the added discomfort. A large safety pin is placed through the tube just piercing the margin of the lumen. A strip of adhesive passed through the closed pin will hold the tube in place without causing any discomfort. When the nephrostomy is done in this manner, postoperative adhesions are limited to a small area of the kidney and a subsequent nephrectomy is much more easily accomplished.

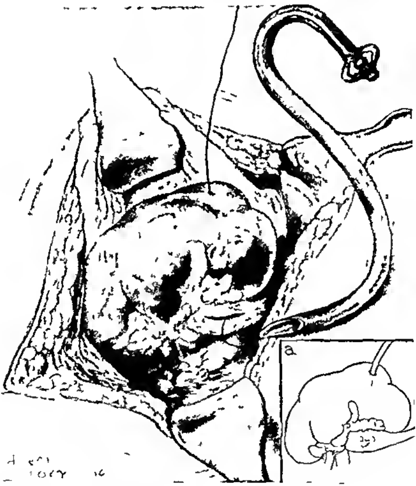

FIG. 174—Method of placing a nephrostomy tube suggested by Cabot. A bent probe is passed through a pyelotomy wound and out through the lower calyx of the kidney; a stout thread is tied around the end of the probe and the probe is withdrawn, pulling one end of the thread through the pyelotomy wound. The thread is then sutured to the beveled end of the Pezzer catheter and the catheter is drawn through the kidney until the tip rests in the renal pelvis. A nephrostomy tube can be placed by this method without delivering the kidney and with very little injury to the cortex.

Cabot's Nephrostomy.—For either temporary or permanent drainage of a functioning kidney, the method advocated by Hugh Cabot is satisfactory and causes very little trauma to the kidney. A small incision is made in the pelvis of the kidney, or in the *ureter when the pelvis is intrarenal*. A bent uterine probe is passed through the pelvis and out through the parenchyma near the

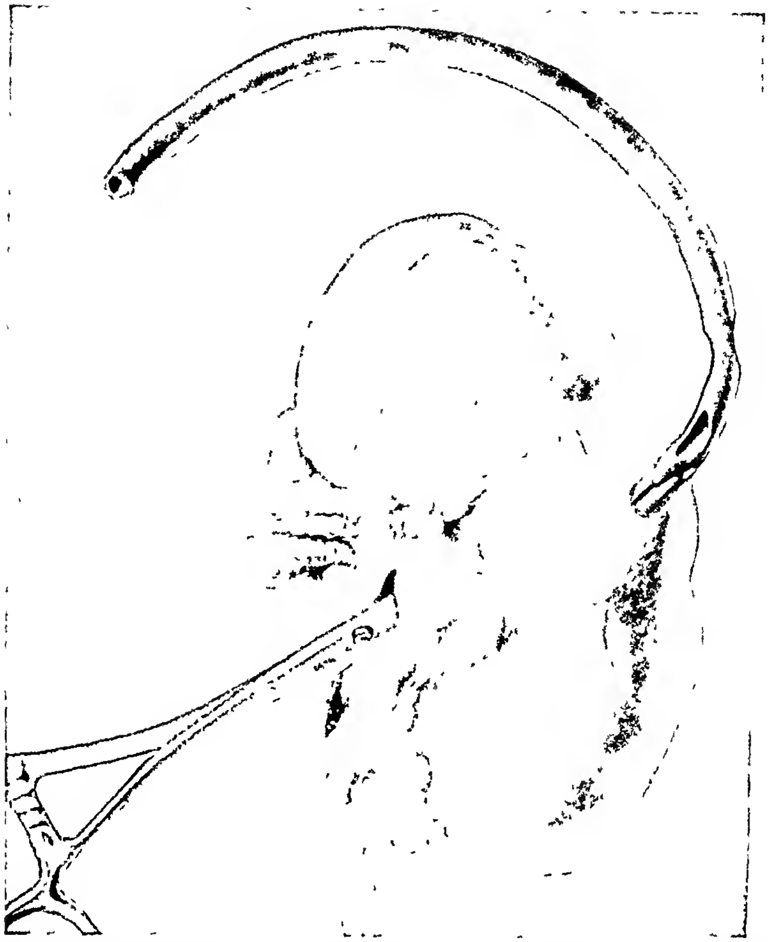

Fig 125 —Method of placing a nephrostomy tube as described by Horsley The tip of a curved hemostat is passed through a pyelotomy wound and thrust through the middle or lower calyx of the kidney The tip of a large catheter is grasped and drawn into the renal pelvis

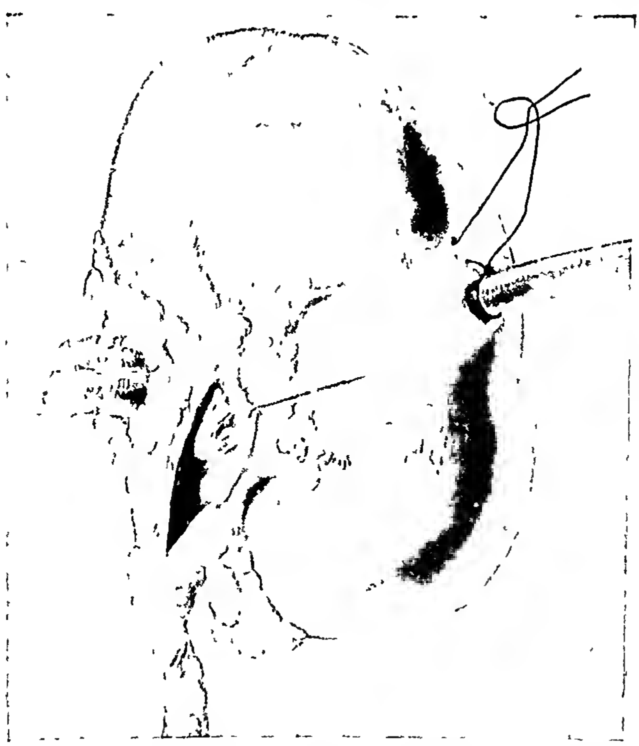

Fig 126 —When the catheter is adjusted so that the tip rests in the pelvis of the kidney, it fastened to the capsule of the kidney with a single stitch of No 0 chromic catgut

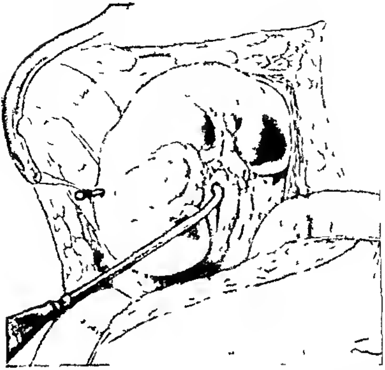

Fig 127—The author's modification of Cabot's nephrostomy The pelvis is opened and a bent probe is thrust through to the cortex near the lower pole A suture is taken through the tip of a catheter and tied to the end of the probe As the probe is withdrawn the tip of the catheter is drawn into the pelvis of the kidney The suture is removed and the catheter is sutured to the renal capsule as described in Fig 126

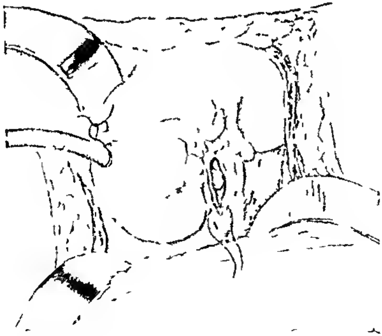

Fig 128—With the drainage tube properly adjusted and sutured to the renal capsule the pyelotomy wound is closed with interrupted sutures of fine plain catgut

lower hole and in such relation to the convex border that the tube will not be exposed to angulation when the kidney is in normal position. A thread of heavy silk is attached to the end of the probe. The probe is withdrawn, pulling the attached end of the silk thread through the opening in the pelvis. The end of a 5 c c. Foley catheter about 22 F is attached to the silk thread. The thread is then used to pull the catheter through the kidney until the end lies in the pelvis. The catheter fits tightly in the renal parenchyma and no bleeding is caused. It is not necessary to suture the catheter to the kidney or to the overlying tissues.

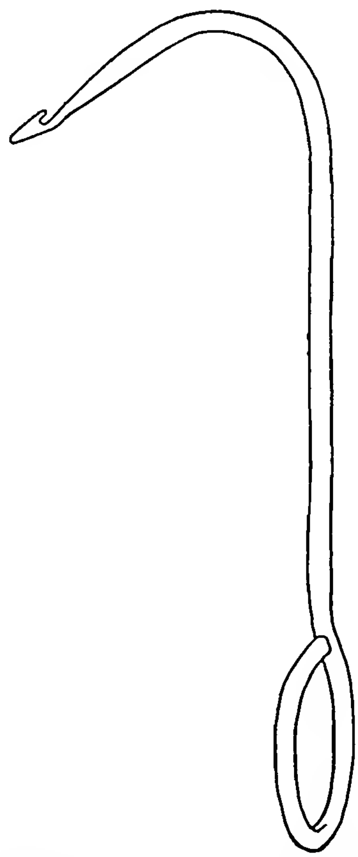

Fig 129—Kimball's nephrostomy hook This instrument is used in the same manner as the bent probe, Fig 127 The hook fits the eye of an especially constructed catheter, which is drawn into the renal pelvis and the hook disengaged

When the kidney can be easily delivered from the wound, a curved forcep may be passed through the pelvis and pushed through the parenchyma, to grasp the tip of a catheter which is then drawn through the kidney (Figs. 125 and 126). This requires complete mobilization of the kidney and causes more trauma than when a probe is used (Figs 127 and 128) Kimball has devised a set of nephrostomy hooks of various angles with a special, hollow-tip catheter that is threaded over the end of the hook and drawn into the kidney (Fig 129) The drainage tube can be placed a little more quickly with this instrument, otherwise it offers no advantage over the method of Cabot and the disadvantage of requiring special instruments.

Marion's Nephrostomy.—When it is difficult to expose the pelvis of the kidney the nephrostomy described by Marion may be employed The renal capsule is incised for about an inch and a small speculum is thrust through the parenchyma into the pelvis, the blades are opened, and a tube is inserted into the pelvis As previously stated the tube should be so placed that it will lead to the surface in a straight line

When the nephrostomy is done for permanent drainage, the ureter should be ligated near the kidney when it is practical to do so

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CHAPTER VIII

RENAL TUBERCULOSIS AND ITS TREATMENT

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Since the discovery of the tubercle bacillus by Robert Koch in 1882 controversies continue to arise as to the correct treatment of the urinary tract when invaded by this bacillus, for seldom are two cases alike. Such variations make renal tuberculosis an intriguing disease.

Many facts are to be considered when attempting a cure of a disease of such manifold manifestations While there are different groups of tubercle bacilli, the human, the bovine, and the avian, the clinician recognizes that one patient is infected by a strain of virulent bacilli, while another is attacked by one of low virulence. If these groups are further divided into strains, perhaps we will be able to predict with greater accuracy the course of the disease.

The urologist must be cognizant of the fact that every patient with renal tuberculosis does not have a demonstrable lung lesion. About 38 per cent show such lesions He must recognize the fact that renal tuberculosis is not emergency surgery and there is sufficient time for a complete and accurate diagnosis He must also recognize the fact that no case of primary vesical tuberculosis has ever been proved He must consider renal tuberculosis in the primary stage as being bilateral, as proved by E M. Medlar (Am. J. Path. 2 · 401, 1926) Time is the greatest factor in determining whether bilateral lesions will progress to the fulminating stage or heal.

It has been a custom over the years for writers on this subject to state that the kidneys receive their tubercle bacilli by one or more of four routes, the blood stream, the lymphatics, by ascension up the ureter, and by contact I have never seen a tuberculous kidney receive its infection except through the blood stream The lymphatics lead away from the kidneys and it is very improbable that any organ receives an infection against its normal channel flow. The ureteral and pelvic mucosa can be infected by regurgitation from tuberculous bladder urine, but the kidney itself is not invaded I saw a ureter that passed through a caseous, tuberculous pelvic gland, and tubercle bacilli were found in the urine from that side, but the kidney showed no lesion, so one has to assume that the kidney might be invaded by contact with a perirenal tuberculous abscess or from a tuberculous suprarenal gland.

A short time ago there was little doubt in the mind of any urologist as to the best procedure in dealing with the unilateral tuberculous kidney produc-

ing symptoms, but with the advent of streptomycin and its derivatives, the question arises as to the length of time one gives well defined lesions or slightly involved kidneys to heal before resorting to surgery With the use of new antibiotics we may have to set up a different criterion for surgery My opinion as to when to operate is governed by the healing of the bladder lesions I have never seen a patient with a tuberculous vesical ulcer recover without renal surgery Should the patient's bladder lesions refuse to heal under present or future bactericides, then the offending kidney should be removed

DIAGNOSIS OF RENAL TUBERCULOSIS

The diagnosis of renal tuberculosis is made much earlier today than twenty years ago This is due to many factors The most probable is the increase in the number of competent urologists who have taught the family physician that his patient with a painful and persistent desire to void requires an examination beyond his ability to give

We have been taught over the years that the urine from a tuberculous kidney patient had certain characteristics, namely that it had a pale milky color, low specific gravity, was persistently acid in reaction in the face of alkalies by mouth, and that the stained, centrifuged specimen revealed only scattered lymphocytes and no bacteria If all tuberculous urine followed this general pattern, it would be simple, but the research work by Alcorn and Buchtel (J Urol 39 No 3, March, 1938) proved that 44 7 per cent of urine containing Koch s bacilli had a mixed infection and the pH followed the general range of normal urines This leaves 55 3 per cent that could be bacteria free with simple stains All suspected tuberculous urines are to be cultured and inoculated into a guinea pig for absolute proof

As to the source of the tubercle bacilli in any urine, every method at our command must be employed to locate it Intravenous urography is now being used by both the urologist and the internist in a study of the renal and ureteral changes as well as the comparative function of the kidneys This type of examination gives only relative results It is necessary in all cases of renal tuberculosis that a cystoscopic inspection of the bladder be made and catheterization of each ureter be done when possible There are few urinary tract lesions as painful as a tuberculous bladder, and spinal anesthesia is of great assistance in the examination

A tuberculous bladder has many characteristics that only experience will teach one to recognize, for one seldom sees two bladders in the same degree of ulceration, though a characteristic ulcerated ureteral opening on the side on which the kidney lesion is located is quite constant In the early stage of infection the mucosa around the ureteral meatus resembles the first blush of a labial fever blister and from this stage to the chronic ulcerated fibrotic ureteral meatus, known as a golf holed ureter, the changes are varied

Care should always be exercised in catheterizing the ureter in the tuberculous patient Force is never to be used in an attempt to pass a tuberculous stricture Overdistending a tuberculous renal pelvis with pyelographic media

may produce miliary tuberculosis. Urine should never be collected from a supposedly good kidney for guinea pigs or cultures unless the catheter is closed until it enters the ureter. Often the diagnosis by exclusion is a positive one and much safer for the patient.

The removal of the so-called self-nephrectomized kidney has always been a debatable question. In my opinion it should be removed, as it is a constant danger as a tuberculous focus (Fig 130). The question as to whether tubercle bacilli pass through a healthy kidney without producing a lesion is debatable in the minds of some urologists. In the National Jewish Hospital of Denver, an institution given to the care of tuberculous patients for forty-nine years, never has a patient in whom Koch's bacillus was found in the kidney failed to show a demonstrable lesion, either during life or at autopsy

Fig 130 —A large calcified left kidney with a tuberculous lumbar spine Normal right pyelogram

An opinion in bilateral renal tuberculosis should be given only after careful evaluation of the findings as brought out by blood chemistry, intravenous and retrograde pyelograms, as well as the extent of lung involvement Bladder distress plays a major role in practically every case of renal tuberculosis This is especially true in the bilateral cases, for the entire bladder is more likely to be involved, causing great distress, with loss of rest, a necessity to the patient's recovery.

Fig 131 —Pyelogram of advanced renal tuberculosis renal pelvis contracted calyces dilated and margins irregular Near the upper pole a cavity communicates with the dilated upper calyx

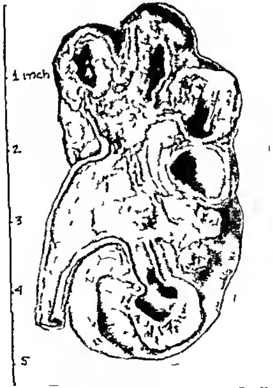

Fig 13 —Extensive tuberculous pyelonephriti The pathologic change is similar to that illu trate l by pyelogram in Fig 131

A totally destroyed kidney should be removed if the opposite kidney, even though infected, is capable of sustaining life (Figs. 131, 132, and 133). Where both kidneys are equally involved and bladder discomfort is not relieved by antibiotics, a bilateral ureterocutaneous anastomosis should be performed, for it is imperative that the patient have the bladder distress relieved. With the ureters in the skin, streptomycin can be applied directly to the involved area, and this promises to be quite helpful in the treatment of bilateral infections.

If tubercle bacilli are free in the blood stream, more than one lesion is to be expected (Fig. 134). Tuberculosis of the spine is a common complication, making kidney surgery more difficult, but should not be considered a contraindication for nephrectomy, as every focus that can be removed offers the patient a better chance for recovery Pregnancy should also not be considered a contraindication to nephrectomy.

Fig 133 —Sclerotic type of renal tuberculosis Small active lesion near lower pole of the kidney Renal tissue mostly replaced by fibrous tissue History indicated that the disease had existed for twenty years

One must bear in mind that renal tuberculosis is a local manifestation of a constitutional condition, and as we have accepted Medlar's findings we are confronted with the possibility that the supposedly healthy kidney may again become activated To prevent this from happening before the patient is dismissed as cured, every precaution in the way of bed rest and the use of the most beneficial anti-tubercle-biotics must be employed.

The following discussion of the use of antibiotics was added by the author (Dodson)

After ten years' experience with streptomycin in the treatment of tuberculosis of the urogenital tract, urologists are in general agreement that this antibiotic is a valuable adjunct to the well established principles of treatment, but should not be used to supplant them Bed rest, a nutritious diet and the excision of localized tuberculous processes are essential to the best interest of the patient In all reports in which a sizable series of patients has been treated the results of streptomycin therapy have been excellent when the lesion was

Fig 134 —Bilateral calcified psoas abscesses necrosis of the spine tuberculosis of the right kidney and duplication of the right ureter

small especially in renal tuberculosis with no gross change in the pyelogram In those patients with moderate to extensive changes in the pyelogram, the antibiotic has been decidedly less effective

At the present time (1955) there is no standardized method of administering antituberculous medication

Nesbit and Mackinney advise the following method of treatment complete rest in a sanatorium, dihydrostreptomycin 2 Gm daily and PAS 12 to 15 Gm daily Isoniazid is added when a second course of therapy is indicated either for the relapse cases or for those which fail to respond to a 90 day course

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The lumbar incision through the skin and muscles is the same for a tuberculous kidney as in any other renal surgery. The incision begins just below the twelfth rib on the quadratus lumborum muscle and extends transversely and slightly downward to one half inch above the iliac crest. An incision of this type can be continued as far as desired. If the kidney is fixed, as shown by x ray, the incision should follow the lower border of the twelfth rib, for removal of the rib may be desired. Every care should be exercised to avoid the twelfth nerve, for when this is cut, the patient will have a relaxed abdominal wall, as well as anesthesia over the distribution of the nerve. The ilio inguinal and iliohypogastric nerves run along the edge of the psoas muscle and are easily recognized.

If Gerota's capsule is opened as far back as the psoas muscle permits, no danger of injuring the peritoneum will be encountered. In children the pleural fold is frequently below the edge of the twelfth rib and is easily opened. Should the twelfth rib be removed, care must be exercised not to tear the diaphragm with a retractor. If the pleural cavity is opened, repair as soon as possible is instituted, with the anesthetist forcibly distending the lung. The patient who is under spinal anesthesia should have a catheter introduced through the rent in the diaphragm and air aspirated as the last stitch is closed around the catheter.

Only after Gerota's capsule is opened and the kidney is inspected can the operator accurately judge the difficulty of delivery. The more adherent the perirenal fat, the greater the danger of accidentally entering the peritoneal cavity, and if this should happen the kidney must be free from all peritoneal attachments before a repair is attempted. There is not as much risk of peritonitis as our textbooks have led us to believe.

Many operators prefer separating the kidney from the perirenal fat by blunt dissection. It is safer and more satisfactory to have the assistant pick up Gerota's capsule with Kelly forceps as sharp dissection is done with scissors. After the peritoneal side of the kidney is freed down to the renal pedicle, the upper pole is then exposed. Frequently the suprarenal gland is densely adherent to a tuberculous kidney. If possible, this is separated from the kidney capsule by sharp dissection, as blunt and blind dissection tears this very friable gland. The resulting hemorrhage from suprarenal gland vessels is most difficult to control and the simplest way is to place a wet pack in the suprarenal fossa until the kidney has been removed.

If the kidney pedicle is fixed, the delivery of the upper pole is difficult and cannot be accomplished until the lower pole with the ureter and pelvis is first freed. Every care must be exercised not to rupture the renal pelvis. The subcapsular delivery of the kidney should be avoided.

To accomplish the ideal nephrectomy in tuberculosis of the kidney, one exposes the ureter by careful dissection for several inches down and then the kidney pelvis up to the renal pedicle. When the pedicle has been stripped of its redundant tissue it is ligated with two No 2 chromic catgut ties. This is much safer and easier than employing the two clamp method, for the operator will have all the vessels in the ligatures by this procedure. There is not the risk

of treatment. In unilateral renal disease when the lesions are small, if there has been no substantial improvement in 60 days, a nephrectomy is performed and the antibiotic program continued an additional 30 days. If the initial examination demonstrates a moderate to advanced destructive process, the kidney is removed after 10 days of antibiotic therapy and the regimen continued through 90 days. The patients are kept under observation with periodic x-ray and laboratory studies, and appropriate treatment is instituted in the event of recurrent tuberculous activity.

Lattimer and his co-workers have concluded that short courses of treatment are not sufficient to permanently sterilize most tuberculous lesions and suggest smaller doses over a prolonged period. At present they administer 1 gram of streptomycin every third day and PAS, 3 grams four times a day, from one to three years They feel that with this regimen, resistance to streptomycin will be deferred and that bacteriostasis may persist long enough for healing to take place. In severe cases a short period of more intensive antibiotic therapy is administered, to be followed by the usual course of treatment.

Para-aminosalicylic acid (PAS) prevents or retards the resistance of tubercle bacilli to streptomycin and probably improves the therapeutic effect. It is relatively nontoxic and is used almost routinely as an adjunct to the antibiotic therapy.

Isoniazid (isonicotinic acid hydrazide) is believed to possess a high degree of antituberculous activity. The recommended dose is 3 to 5 mg. per kg. of body weight It is usually added to streptomycin and PAS in resistant cases It is contraindicated for patients with severe renal damage and unstable mental states

NEPHRECTOMY

When the surgeon is satisfied that a nephrectomy is indicated, there are factors that will lend to its success The anesthetic should be one that will not irritate the lungs, even though no demonstrable lesion is present Spinal anesthesia is the preference of many surgeons, but this is contraindicated in spinal fusions In my opinion, Pentothal Sodium, supplemented by oxygen and nitrous oxide, is more satisfactory in all cases

Before the patient is placed on the operating table, a review of the x-ray pictures should be made as to the condition of the lumbar spine and the space between the twelfth rib and the crest of the ilium One roentgenogram with the patient in the upright position will reveal whether the kidney is fixed. This is quite an important picture, as it determines whether the twelfth rib is to be removed for better operative exposure.

The proper placing of the patient on the operating table is essential for good renal surgery. Every well-equipped operating room now has tables with a kidney elevator, which is adequate for the proper position in the adult, but for children the sandbag is more satisfactory.

in a right nephrectomy of clamping the duodenum and injuring the vena cava if clamps are not used. If the ligatures are properly tied, the change in the color of the kidney indicates it. Before cutting the kidney from the ligated pedicle, the vessels are fixed with two Kocher clamps, one above and the other below, so as to have control if a ligature slips. After the kidney is cut from the pedicle, a third ligature may be tied below the two forceps, or the vessels may be ligated separately.

The kidney, freed from the blood supply but still attached to the ureter (Fig. 135), is wrapped in a wet pack and placed on the abdomen until the wound is closed down to the ventral end of the incision where the ureter is to emerge. When the wound is closed, the ureter is attached to the skin with two fixation sutures and cut from the kidney pelvis, leaving a centimeter and one half protruding from the wound. In this type of nephrectomy there is little chance for infection to follow. Many surgeons close tuberculous wounds without drainage. It is my custom, however, to insert one or two Penrose drains in the upper angle of the wound.

In the tuberculous kidney with dense adhesions about the ureter and pedicle it may be necessary to cut the ureter in order to deliver the kidney (Fig. 136). In this case every precaution must be used to prevent contamination of the wound, for it is at this stage that infection occurs. A carbolized knife is used to sever the ureter between ligatures close to the pelvis and the two severed ends are carefully swabbed out with a carbolized applicator. A hypodermic syringe is then used to inject 3 cubic centimeters of pure carbolic acid into the ureter through its side wall.

COMMENTS

The advisability of removing the perirenal fat has been under discussion for many years. I remove along with the kidney only that fat that is adherent to the capsule, for no tubercle bacilli have been demonstrated in the fat except in those extremely rare cases that have developed a perirenal abscess.

The disposition of the ureter is of greatest importance in all cases of renal tuberculosis, as one is dealing with an infected tube that is capable of keeping the bladder contaminated with bacilli and infecting a wound that great care has been used to protect. The textbooks have advised two methods of caring for the ureter, namely, removal of as much of the ureter through the kidney incision as is possible, or a ureterectomy at the time of the nephrectomy. Both of these methods have faults. When the ureter is tied off low in the iliac fossa the remaining portion of several inches is still an infected tube. If there is a stricture at the lower end of the stump (Fig. 137), this would gradually fill with pus and the back pressure would eventually force open the ligated end, thereby contaminating the deepest part of the iliac fossa. When there is a [illegible] hole ureter but no stricture, at each voiding there is regurgitation up the [illegible] and pressure would finally force open the upper end of the ureter. The patient who has been afebrile and whose incision has closed by primary [illegible] develops fever and a painful, indurated wound, which either breaks [illegible]

Fig 135—Kidney freed from the blood supply but still attached to the ureter

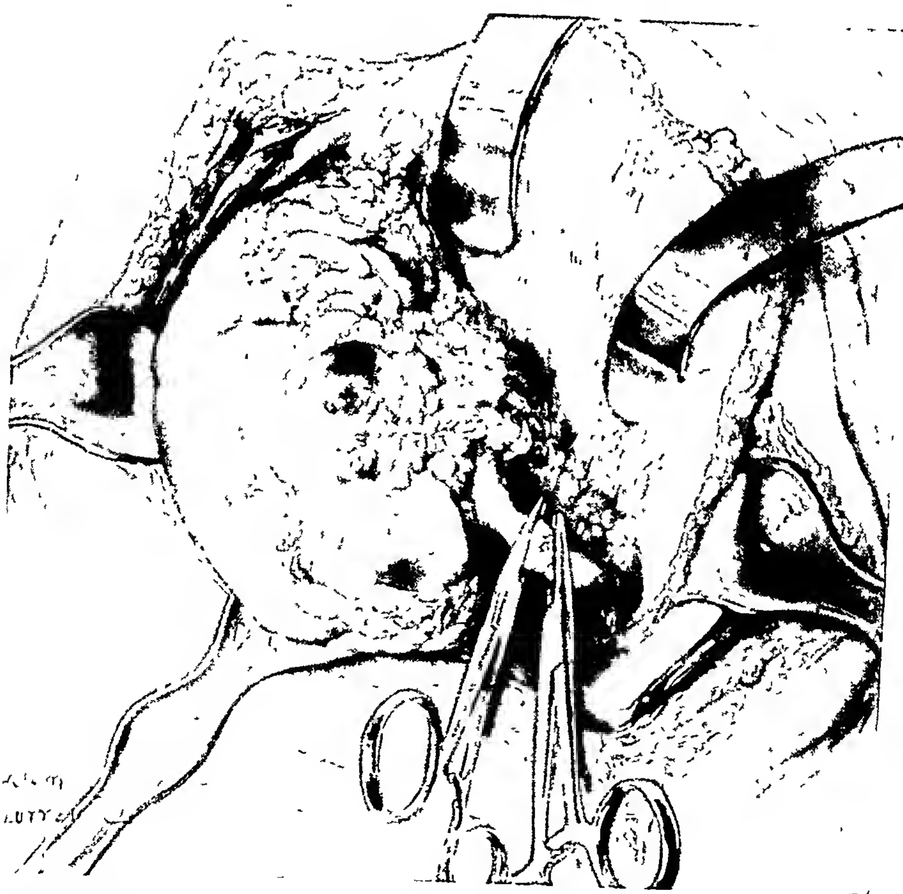

Fig 136—Nephrectomy for renal tuberculosis The perirenal fascia reflected medially protects the peritoneum Usually the operation is simplified by first freeing the lower pole of the kidney and clamping and dividing the ureter The upper portion of the ureter and renal pelvis may then be used as a guide to the renal vessels When the upper pole of the kidney is densely adherent, the operation is simplified by clamping and dividing the renal vessels before freeing the upper pole Perirenal fat and fascia adherent to the kidney are removed with it.

bladder ulcers have healed, bladder contraction frequently continues Varied procedures have been used in the dilation of this type of bladder, often with poor results, as scar tissue produced by tubercle bacilli is very fibrous in character Bags introduced through the urethra and distended while the patient is under spinal anesthesia are probably the best of mechanical dilators In some cases the only relief is to transplant the healthy ureter to the skin or intestine Many tuberculous bladders develop a contracted neck, with a resulting retention Though this retention is only an ounce, a transurethral resection should be done, for this extra capacity means added comfort

Every urologist knows that many nephrectomy wounds heal without infection and bladders improve when the tuberculous kidney is removed, but some do not, and in order to treat this latter group properly the surgeon should employ the most satisfactory methods An attempt has been made in the foregoing chapter to describe the methods that have proved most satisfactory in my hands It is hoped that with the advent of new antibiotics the distress and complications that accompany tuberculosis of the urinary tract will be completely eliminated and the longevity in these unfortunates materially increased

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entirety or develops many sinuses leading to the stump of the ureter. A complete ureterectomy at the time of the nephrectomy is a major operation and few patients should be subjected to such a procedure. Furthermore, when the ureter is removed, a very simple method of treating a tuberculous bladder is eliminated.

The method of transplanting the ureter to the skin was first described by Dr. William Mayo, but no attempt was made to use it in the treatment of the tuberculous bladder.

Fig 137 —Thirty-minute intravenous pyelogram of 10-year-old boy with tuberculous stricture in lower ureter

In ureters that have been transplanted to the skin, when bladder distress is not a prominent factor, simple ligation is all that is necessary. It is not unusual to see a ligated end open up and discharge a creamy pus at intervals during the first six months If the bladder requires treatment, a snugly fitting catheter should be introduced a short distance down the ureter and through this catheter the tuberculous ureter and bladder can be treated by instillation, and with a Bardex catheter in the bladder continuous irrigations may be immediately instituted if warranted. The two most satisfactory solutions are a 1 per cent aqueous methylene blue and a 5, 10, or 15 per cent solution of alcohol. After

Indirect force by strenuous muscular exertion has led to rupture of the kidney, according to isolated reports Dodson (1944) described a patient who injured his kidney lifting a heavy box, and Keyes (1936) described a similar injury in a patient who "whiffed" during a golf game Others have described an insignificant degree of exertion which has resulted in renal injury, although in most instances an already abnormal kidney was present Pre existing disease makes the kidney more vulnerable to injury, as illustrated in Fig 138

Fig 138—Left hydronephrotic kidney with hydroureter shows rupture at lower pole with extravasation medial to the descending colon caused by minor injury

Blast syndrome and its effect on the kidney were well recognized during the recent war A near by shell or bomb explosion led to the disability, which was manifested by oliguria or anuria Robinson (1946) reported 25 cases, none of which required surgery

CHAPTER IX

INJURIES OF THE KIDNEY AND THEIR TREATMENT

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Renal injury is not uncommon and may follow several different types of accident Although many patients with an injured kidney will not require surgery, some will need operation to save life or to avoid late complications The following discussion of the clinical aspects of the subject is designed to show whether or not surgery is indicated in a particular case and to suggest the proper surgical approach.

TYPES OF FORCE PRODUCING INJURY

Penetrating wounds of the kidney caused by bullet, shell fragment, and stabbing are commonly associated with wounds of adjacent viscera Treatment of chest or intraperitoneal injuries takes precedence over the renal condition, although all of the injuries may be handled surgically at one sitting if the patient's condition permits. Robinson et al (1946) found that during the recent war 70 per cent of the patients with renal injury caused by penetrating wounds also had wounds of other important structures Thirty-two per cent of the renal injuries required nephrectomy Kimbrough (1946) reported similar findings, with 24 per cent requiring nephrectomy, and he again emphasized the seriousness of the associated wounds of chest and abdominal viscera.

Direct force applied suddenly to the kidney region either anteriorly or posteriorly is the most common type of accident in civilian life The severity of the blow does not, however, indicate the severity of the renal injury. The kidney is fairly well protected by the lower ribs, the muscles of the flank and back, the vertebral column, and intraperitoneal organs According to Keyes and Ferguson (1936), Küster believed that external violence could rupture the kidney full of blood in the way that a bag full of water might burst when hit, but Keyes surmised that the rupture of the kidney might be due to reflex muscular contraction rather than the blow itself Experimental work in animals led Stirling (1936) to conclude that the force necessary to rupture the organ is essentially the force that will produce a primary divulsion of the capsule.

Football injuries caused, for example, by using the body trunk to block a runner, falls resulting in injuries in the lumbar region, skiing and tobogganing mishaps, and automobile, motorcycle, and bicycle accidents are the most frequent causes of renal injury.

True rupture indicates one or more gross lacerations involving both the renal capsule and parenchyma. When multiple, the lacerations extend in stellate form from the hilum, although complete transverse fracture of the kidney has been observed by us more than once. Often the laceration involves one or more calyces and may extend into the renal pelvis. When a calyx or the renal pelvis is involved, there will be extravasation of urine into perirenal tissue if the kidney is still functioning. Severe damage may result in pulpefaction of the renal substance.

Laceration of the pedicle leads to perirenal hematoma and may cause an infarct of the kidney itself.

Secondary changes may follow the primary renal trauma. Infection in the traumatized renal tissue may produce a true pyelonephritis. Infection in perirenal hematoma may lead to perinephric abscess. Extravasation of urine into perirenal tissues will likewise cause tissue necrosis and abscess. Damage to renal circulation may result in atrophic changes subsequent to infarcts. Accumulation of encysted fluid in a hematoma may lead, months or longer after the injury, to the so called pararenal pseudohydronephrosis.

SYMPTOMS

Shock, pain, and hematuria are the primary symptoms, all variable in extent and at times supplemented by a palpable mass in the flank.

In general, especially in the nonpenetrating types of injury, two groups of patients are seen. Those of the first and smaller group are admitted in a severe state of shock, perhaps due to hemorrhage, with rapid pulse, restlessness, pain, spasm, and a large palpable mass in the flank. Even with supportive treatment these patients may not reach the operating room for surgery. A much larger group is comprised of those admitted to hospital, perhaps hours after injury, in good general condition, but with pain in the kidney region and evidence of some degree of hematuria.

Shock, except in very severe injuries, is not typical in patients with renal trauma. Many patients with complete transverse rupture have shown no evidence of shock. When shock is present, therefore, it signifies extremely severe renal damage, a tear in the peritoneum in conjunction with the renal injury, or rupture of an intraperitoneal viscus. Keyes (1936) has seen rupture of the peritoneum in association with a nonpenetrating type of renal injury only in children.

Pain is a common symptom, usually located in the costovertebral angle, flank, or upper abdominal quadrant. The pain can be due to the kidney injury itself or trauma to flank muscles, ribs, or transverse processes. It is difficult to tell by clinical examination alone the exact cause of the pain.

Hematuria is the second common symptom and may be of any degree, microscopic or gross. Except in injuries of the renal pedicle and minor contusions, hematuria is usually gross and often severe. The degree of hematuria is, however, not in itself an indication of whether or not the injury needs surgical treatment. Catheterization of the bladder for urine specimen is justifiable if the patient cannot void.

PATHOLOGICAL CHANGES

The extent of renal trauma varies widely. The reason for attempting a classification of the type of injury is that treatment is based to some extent on the type of injury, even though at times it may be difficult to learn by clinical examination just what changes have occurred. The following simple scheme is useful for our purposes: (1) contusion, (2) subcapsular rupture, (3) true rupture of cortex and capsule (single or multiple), and (4) laceration of pedicle. Various degrees of renal injuries are schematically illustrated in Fig. 139.

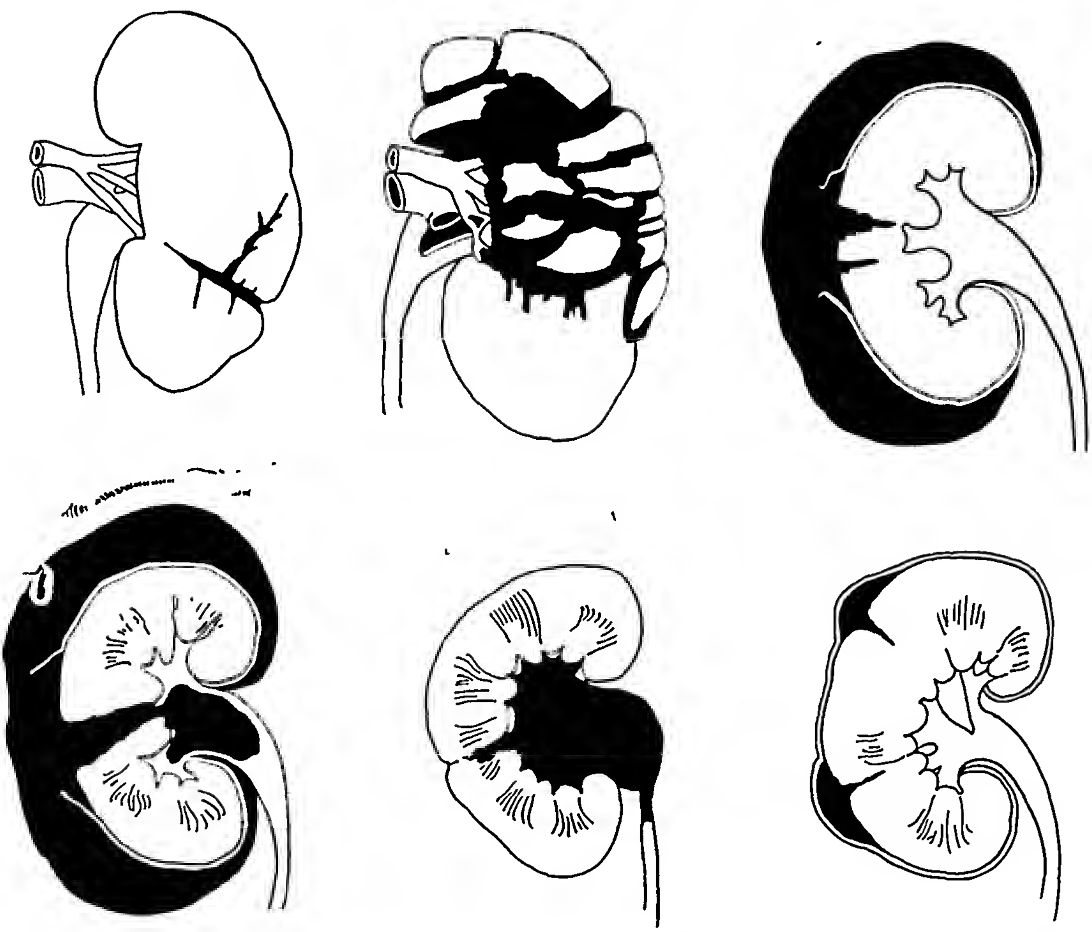

Fig 139.—Schematic drawing of various types and degrees of renal injury (after Papin) From left to right, polar rupture (fissure), renal fragmentation with vascular injury, cortical laceration with perirenal hematoma, the same, but involving renal pelvis, pelvis hematoma secondary to parenchymal injury, cortical lacerations with small subcapsular hematoma (Redrawn from Osgood and Campbell Injuries of the Kidney, Lewis Practice of Surgery, W F. Prior Company, Inc)

Contusion of the kidney with ecchymosis and some hematoma in the renal cortex, but without any gross crack in cortical substance, represents the mildest form of renal injury

Subcapsular rupture is less common than contusion or true rupture. There is a gross break in the continuity of renal parenchyma, which can at times be demonstrated by pyelograms, yet the capsule of the kidney remains intact and prevents extravasation of blood or urine

With intravenous urography the injured kidney was visualized, but secretion was delayed or scanty in several. The opposite kidney was visualized in all. When intravenous urograms were repeated after an interval of more than 7 days, improved visualization of the injured kidney was obtained.

Blood pressure and pulse rate remained normal, and the urine became grossly clear in an average of three days. Some cases still showed microscopic hematuria ten days after injury.

No surgery was used in this group, and there were no fatalities.

The important clinical features which would appear to indicate a contusion of the kidney may be listed as follows: no evidence of shock, no fall of blood pressure and no rise in pulse during the first forty-eight hours, *no increase* in flank tenderness or spasm during the first two days and visualization of the injured kidney in the majority by intravenous urography soon after injury.

Only one case in Prather's series was diagnosed "subcapsular rupture," but in that patient the findings were similar to those listed as contusions. Retrograde pyelography demonstrated the lesion. Intermittent hematuria continued for twenty days following injury.

The group listed as "true rupture" presented more definite findings which help to distinguish them from the simple contusion.

Two patients were admitted moribund, in a state of shock, with a bulging flank mass. They died within a few hours after hospitalization before supportive treatment or surgery could be of benefit. These two patients were the only ones who had a definitely palpable mass in the flank. Autopsy proved extensive widespread retroperitoneal hematoma in both cases.

The majority of patients who were ultimately proved to have true rupture were not in shock at time of admission to hospital, but the pulse rate rose in 50 per cent during the succeeding forty-eight hours.

All patients had pain in the kidney area immediately after injury and half of them had nausea and vomiting. Both tenderness and spasm of flank muscles were present in all and, more significantly, the pain and tenderness *increased* during a forty-eight hour period. There was an associated increase in tenderness in the corresponding lower abdominal quadrant, indicating perirenal extravasation of blood or urine or both. Twenty-four hours after injury the patients were comfortable only with the hip flexed, and extension of the hip produced pain in the lower abdomen and flank. We believe this indication of psoas spasm is an important clinical finding which will often enable one to make the diagnosis of true rupture and lead to surgical intervention before significant changes in pulse or blood pressure occur.

Intravenous pyelography demonstrated the uninjured kidney in all and demonstrated extravasation from the injured kidney in one case. It was misleading in two cases, in which the injured kidney appeared to fill reasonably well but in which later surgery demonstrated major lacerations involving a calyx. Lack of visualization in one case was later proved to be due to a complete transverse rupture of the kidney. X-ray data appear helpful but not always conclusive in demonstrating the exact nature or extent of the injury.

A mass in the flank has in our experience more often been absent than present. Tenderness and spasm around the affected side make accurate palpation difficult When present, an early palpable mass indicates considerable hematoma and, at a later date, abscess.

X-RAY EXAMINATION

If blood pressure level is sufficient for urinary excretion we recommend a plain x-ray film of the kidney region, followed by an intravenous urogram as soon as practicable

In the plain film the presence and size of the kidneys are noted. Lower ribs and vertebral column are inspected for fractures. The presence or absence of the psoas shadows are also noted. In our opinion, intravenous urograms are indicated before cystoscopy is considered From the intravenous urograms one expects to determine the presence and the condition of the uninjured kidney and to obtain some information about the injured kidney. The intravenous urogram does not give infallible information In a previous study we found that in some instances the pyelographic pattern would appear reasonably normal even though the kidney was lacerated. Furthermore, absence of visible excretion of the opaque dye by the injured kidney may or may not indicate serious injury Extravasation of the secreted dye beyond the kidney margin is an indication for prompt surgery, but dye confined within the area of the kidney may indicate only a subcapsular rupture Stereoscopic films are an aid to determine the location of the opaque material.

Retrograde pyelography is indicated if intravenous urograms fail to disclose the extent of the injury With present-day asepsis the chance of introducing infection is minimal, and there appears to be little or no reason for aggravation of the degree of hematuria. Retrograde pyelograms, however, are not always completely reliable, because of blood clot in the renal pelvis or clot blocking an infundibulum When there is positive extravasation, the findings are significant

CLINICAL COURSE

In order to correlate clinical findings with the type of pathological change in the kidney, Prather has described the clinical course of patients as he classified them

In ten patients with "contusion of the kidney," 80 per cent had pain in the renal area, but only 10 per cent had nausea or vomiting Sixty per cent had gross hematuria, and the remainder all showed microscopic blood in the urine Very mild degree of shock was present in only one of 10 cases On examination 80 per cent had tenderness in the flank muscles, and spasm was present in the same area in 40 per cent. During the first forty-eight hours after admission pain and tenderness did not increase except in one patient, who had fractures of three lumbar transverse processes.

When there is clinical or x-ray evidence of extravasation of urine and blood in perirenal tissue, we advocate surgery, believing that eventually surgery will be required and that better treatment of the renal condition can be given before abscess formation takes place. Exposure should be by a flank incision unless there is reason to suspect intraperitoneal injury. In our experience, operation has often been indicated 3 to 60 hours after injury. Usually perirenal blood and urine have dissected around the kidney and facilitate surgical delivery of the organ. Inspection of the kidney through a flank incision often enables one

Fig 140.—Posterior half of right kidney removed two weeks following injury, rupture into lower calyx with extravasation of blood and urine. Note cortical abscess. There was blood in the urine for twenty four hours following injury. Tenderness and muscle spasm gradually increased. Fracture of pelvis and other injuries caused operation to be delayed. The kidney could have been saved by early operation.

to repair the rent with mattress sutures, especially when the laceration is at the upper or lower pole of the kidney. A cigarette drain down to the repaired tissue or the use of Oxycel will facilitate hemostasis. The kidney itself is usually not drained, but the perirenal tissue should always be drained.

When complete transverse fracture is present or numerous deep rents are noted or infarction is present, nephrectomy becomes necessary, provided the integrity of the opposite kidney has been demonstrated (Fig 140). Especially

Traumatic severance of the renal pedicle must be rare, and it is usually followed by sudden death. Prather (1940) reported a patient who lived for five days after a toboggan accident even though the pedicle had been completely torn across A large, smooth, infarcted kidney was removed. At no time during the five-day illness were there more than a few microscopic red cells in the urine. Death was due to chest complications.

DIAGNOSIS

As Dodson (1944) has stated, "The diagnosis of injury to the kidney is rarely difficult, but the determination of the extent of the injury and of the choice of treatment requires careful observation and the use of every method of examination." Except for the small number who are admitted to hospital in a critical condition, usually due to associated injuries, and in need of immediate supportive or surgical treatment, there is time for a careful evaluation of the condition

The procedures necessary for diagnosis include careful palpation of the abdomen and costovertebral regions This should be done by the same examiner at intervals of several hours during the first few days to discover increase of tenderness, spasm, or indication of psoas spasm The examiner must always be alert for associated chest or abdominal injury.

Blood pressure and pulse determinations at hourly intervals may give a valuable indication of a trend, especially if they indicate hemorrhage, but in many instances it should be possible to arrive at a correct estimate of the injury before sufficient depletion has occurred to make the patient a poor operative risk

Routine blood counts are needed for a matter of record or information, and routine blood grouping may save valuable time later

Urine specimens are needed to note the degree of hematuria, and catheterization to obtain these may be necessary.

X-ray examinations, including intravenous urograms soon after hospital admission, are indicated if blood pressure is sufficiently high to insure secretion of the opaque dye Cystoscopy and retrograde pyelogram of the affected side may be required

After the above information is obtained, the data and the progress of patient are correlated with one's experience and knowledge as to the clinical course of known cases with various degrees of injury The decision to be reached is whether or not surgery is indicated

TREATMENT

In **nonpenetrating injuries** expectant or conservative treatment is the rule, at least until there is definite evidence to warrant surgery A warm bed, sufficient medication to control severe pain, and intravenous fluids or blood are primary measures during evaluation of the injury. If continued study and observation indicate that contusion or subcapsular rupture is present, further conservative treatment is in order. Because of the danger of secondary hemorrhage we deem it good practice to confine the patient to bed for at least one week after gross hematuria has ceased.

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when complete transverse rupture has occurred, careful inspection of the specimen and careful palpation in the depths of the wound are advisable in order not to leave a fragment of kidney behind. The renal fossa is drained to permit continued evacuation of residual serum

In cases requiring surgery, the risk is not great if the operation is undertaken before the general condition of the patient becomes critical.

The above principles of treatment are based on personal experience and recent reports by McKay, Baird and Lynch (1949), and Hodges, Gilbert and Scott (1951) Others, namely Sargent (1945) and Spence, Baird and Ware (1954), propose a more conservative attitude, relying on nonsurgical measure to bring about recovery except for those patients in whom bleeding appears to be out of control and those who develop an abscess in the flank from unabsorbed hematoma or extravasation.

Penetrating injuries of the kidney have usually involved intraperitoneal or chest organs which will likely require immediate surgery. The kidney is thus not of primary concern, but is inspected by palpation during laparotomy If the kidney is badly damaged and the patient's condition permits, transperitoneal nephrectomy is possible If not, a flank incision later can be used to approach the kidney when needed A review of some war injuries disclosed valiant surgery followed by excellent recovery in men with extensive intraperitoneal and renal injuries The generous use of blood and the young age of the group helped skilled surgeons to accomplish many fine results

FOLLOW-UP OBSERVATIONS

Abnormal anatomical and physiological renal and perirenal changes are prone to follow injuries of the kidney. They may be caused by interference with renal circulation (infarcts), fragmentation and isolation of pieces of renal tissue, inflammation, perirenal fibrosis, and ureteral obstruction Patients with minor renal injuries treated conservatively are less likely to show late functional changes than those patients who have had a true rupture of the kidney In a careful follow-up study by Suermondt and Ijdens (1953) it was shown by intravenous urogram that none of 26 cases with minor injury had resultant albuminuria, infection, or renal deformity However, following major injuries of the kidney, treated conservatively, 45 per cent of 31 cases showed deformity in the pyelogram Pararenal pseudohydronephroses, as reviewed by Crabtree (1935), serve to emphasize the possible seriousness of late complications which may occur weeks or months after injury, especially when surgery has not been performed soon after the diagnosis

It is, therefore, important to be vigilant for some months after renal injury, following progress by abdominal palpation, urine study, and pyelographic examination in patients who have not been treated by nephrectomy. Likewise, in those who have had nephrectomy interval examinations are desirable, to evaluate the remaining kidney.

normal If the ureter descends with the kidney, there is no interference with drainage and usually no pathological change or discomfort resulting from the ptosis Pathological changes in the ptosed kidney and the resulting discomfort to the patient are usually caused by interference with renal drainage This is caused by kinking of the ureter over aberrant blood vessels and adhesions to the perirenal fascia or peritoneum which prevent the ureter from descending with the kidney When the kidney is excessively movable, rotation on the pedicle may occur, resulting in congestion and eventual atrophy of the kidney

Diagnosis—The treatment of renal ptosis, particularly the selection of cases for surgical correction, depends upon an accurate diagnosis It is not sufficient to know that the kidney is excessively movable The effect of ptosis upon the kidney, particularly upon the emptying time of the renal pelvis, must be determined and evidence of early hydronephrotic changes recognized It is also necessary to determine the extent to which the ptosis is responsible for these changes Stricture of the ureter, stenosis of the ureteral orifice, or ureteral calculus may produce the same pathological changes and cause the same discomfort, and may be accompanied by a harmless type of renal ptosis

Birdsall found that 122 of 150 patients with renal ptosis complained of pain in the renal area varying from renal colic to dull pain in the lumbar area Forty five patients complained of digestive disturbances, and thirty patients had symptoms suggesting disorders of the nervous system In the report by Fish and Hazzard the symptoms frequently noted were pain in the flank, abdominal pain, nausea and vomiting elevation of temperature, and painful and frequent urination Most authors call attention to previous abdominal operations without relief of pain In some cases there was no discomfort, but the patient sought advice because of a mass in the abdomen

The urogram is the most important procedure in making an accurate diagnosis The intravenous urogram is quite valuable, and in some cases gives all the information needed Pictures should be taken in both the recumbent and upright positions (Figs 58 and 59) A very good idea of the function of the two kidneys can be obtained delayed emptying of the ptosed kidney in comparison with that of its fellow may be noted, dilation of one or both pelves will be recognized, and the location of ureteral obstruction can often be determined A retrograde pyelogram will give more accurate information as to the degree of pelvic dilatation and the emptying time of the pelvis A renal pelvis which appears only slightly dilated by the intravenous method will often be found to be quite large when filled by the retrograde method The tip of the catheter should be withdrawn to the lower ureter while the fluid is being run into the pelvis so that an outline of both pelvis and ureter will be obtained The procedure is repeated with the patient in the upright position to determine the degree of ptosis The ureteral catheter or catheters should then be removed and films taken at five and ten minute intervals to determine the rate of pelvic emptying Frequently the renal pelvis is empty in five minutes, it should always be empty in ten There is the possibility of some delay because of irritation and spasm of the ureter This is negligible if small smooth catheters are passed gently When retrograde pyelograms are made both kidneys should be included

CHAPTER X

NEPHROPTOSIS AND ITS TREATMENT

Diagnosis, Treatment, Nephropexy

NEPHROPTOSIS

Opinions regarding the importance of surgical treatment in ptosis of the kidney have varied considerably in the past. During the latter part of the last century and the early years of the present century there was a wave of enthusiasm for nephropexy Many chronic illnesses, particularly manifestations of diseases of the alimentary tract, the gall bladder, and the nervous system, were attributed to renal ptosis. The operation was frequently done without a careful urological examination; consequently, in many cases so treated ptosis had not disturbed the physiology of the kidney and there was no relationship between the abnormal position of the kidney and the patient's symptoms. The many cases in which nephropexy failed to give relief caused doubts to arise in the minds of both internist and surgeon. As a result, for many years relatively few patients were operated upon for renal ptosis Within recent years, because of added facilities and improvements in methods of diagnosis, the problem of renal ptosis is better understood, and the role of nephropexy more clearly defined.

Renal ptosis has been estimated by various authors to be present in from 10 to 20 per cent of women and approximately 2 per cent of men, but instances in which there is demonstrable pathology or sufficient discomfort to require treatment are relatively few. Observations made by B. A. Thomas, Crabtree and Shedden, Fish and Hazzard, J. C. Birdsall and others indicate that renal ptosis is frequently responsible for renal pathology. Of seventy-five patients with renal ptosis examined by Thomas, there were eighteen cases of pyelitis, three of pyelonephritis, two of pyonephrosis, nineteen of hydronephrosis and ten of calculi. Crabtree and Shedden found ptosis of the kidney a frequent causative factor in persistent and recurrent renal infection Of 3,856 kidney cases treated at the Squire Clinic between May, 1928, and January, 1938, two hundred sixty-three were found to have symptom-producing nephroptosis, unilateral or bilateral. The outstanding pathological changes were hydronephrosis and pyelitis Birdsall found 81 instances of hydronephrosis, 22 of calculi, and 57 of renal infection in 150 patients with renal ptosis. Braasch et al. presented a study of 230 patients with simple ptosis or ptosis with minor degrees of pyelectasis without other evidence of obstruction at the ureteropelvic area Approximately one-third of these patients had no symptoms which were related in any way to the kidneys. In the remainder of the patients symptoms attributable to the kidney seemed not to be influenced by the degree of ptosis.

Pathological changes in the kidney are not at all dependent upon the degree of renal mobility. A kidney that is entirely palpable may be physiologically

at the ureteropelvic orifice can be demonstrated, operative treatment is the only means of relief. Indigent patients are rarely in a position to carry out the palliative methods required and should be operated upon when the pathology or symptoms seem sufficient to require treatment. Those who do manual labor or engage in athletic sports are also more apt to obtain relief by surgical means.

Nephrectomy is indicated when nephropexy has failed to relieve incapacitating symptoms, or when the kidney is of no functional value or is the site of malignancy.

NEPHROPEXY

The purpose of nephropexy is to suspend the kidney and to create adhesions that will hold it in place, thereby improving drainage and preventing traction on the vascular pedicle and adjacent organs. The operation is indicated when ptosis of the kidney interferes with drainage, or when there is persistent pain or gastrointestinal disturbance resulting from the excessive mobility. The kidney should also be suspended following plastic operations on the kidney pelvis, or when, during any conservative operation, the kidney has been completely mobilized. Numerous methods of suturing the kidney in place have been devised, any of which may be successful if the kidney is properly prepared and care is taken to suture it in its normal anatomical position. An important part of the operation is complete liberation of the upper ureter and pelvis and careful dissection of all perirenal fat and fascia from the kidney. The ptosed kidney is often complicated by adhesions of the ureter, aberrant vessels or ureteropelvic pathology. When no such complications exist, pronounced degrees of renal mobility are often recognized in which no discomfort is experienced by the patient and the kidney empties normally.

The Operation.—Regardless of the method of suspension to be used, the preparations of the kidney and its bed are the same. Adequate exposure is necessary so that the kidney, the ureter above the pelvic rim and renal fossa can be easily seen. An ample curved lumbar incision (Fig. 82) is usually more satisfactory, though in very thin patients with sufficient space between the costal margin and iliac crest the straight incision (Fig. 92) is satisfactory and causes less discomfort during convalescence. After making the incision and ligating all bleeding vessels, the operation is continued by first separating the posterior portion of the perirenal fascia from the lumbar muscles. A longitudinal incision is then made in the fascia about opposite the medial border of the kidney and is extended both upward and downward. A clean incision in the fascia permits it to be reflected forward and preserved intact for use in protecting and supporting the kidney when it has been placed in its bed. The fascia after having been divided is carefully dissected from the kidney and, together with the perirenal fat, is reflected medially, carrying before it the parietal peritoneum. These structures are retracted anteriorly, giving adequate exposure to the kidney and the renal fossa. When adhesions from the perirenal fascia to the kidney are not readily separated by blunt dissection, they should be divided with scissors to prevent tearing the renal fascia. The kidney thus exposed is

Regardless of how the pyelogram is made, a cystoscopic study is indicated, to determine accurately the differential function, the presence, location and character of infection, and the condition of the bladder and ureteral orifices. It is also indicated to rule out definitely obstructive lesions in the lower portion of the ureter.

Ptosis of the kidney must be differentiated from small tumors or cysts of the lower pole of the kidney or tumors, either extrarenal or intrarenal, at the upper pole which displace the kidney downward It must also be differentiated at times from abdominal cysts and tumors of the colon This is usually readily accomplished by the pyelogram and occasionally, in addition, a barium enema

Treatment.—When ptosis of the kidney is discovered accidentally by the patient or incidentally during an abdominal examination by the physician, no treatment is indicated unless there is persistent pyelitis or a history of intermittent attacks of renal infection or other associated renal disease There is little probability of the relief of gastric disturbances or neuropsychiatric manifestations by the treatment of renal ptosis unless the ptosis is also causing sufficient interference with the physiology of the kidney to produce some clinical manifestations of renal disease.

The treatment may be palliative or operative (nephropexy or nephrectomy). Palliative treatment consists of rest in bed, preferably with the foot of the bed slightly elevated, improvement of the general condition by correcting the diet, eradicating foci of infection, exercises designed to improve the posture and the tone of the abdominal muscles, and a properly adjusted abdominal support. These measures are frequently helpful and should be tried in cases with moderate degrees of ptosis when there is general visceroptosis, when there is no evidence of pathological change in the ptosed kidney and when intercurrent disease adds greatly to the risk of surgical treatment Patients who suffer from renal ptosis are often undernourished and tire easily Frequently freedom from their usual routine of duties, rest periods in bed, and a diet high in calories and vitamins is very helpful Prolonged rest in bed with the idea of adding fat to support the kidney is not apt to be permanently successful If the patient is to remain in bed several weeks, nephropexy adds little to the discomfort and gives more positive chance of cure. Abdominal supports rarely hold the kidney in place even with a kidney pad, but the support seems to give a measure of relief and should be tried when there is no dilatation of the renal pelvis or chronic renal infection.

Nephropexy is indicated when palliative measures have failed, when there is retention of urine in the renal pelvis, when there is infection of the kidney unrelieved by medical treatment, and when the patient does manual labor or engages in athletic sports. Most patients when seen by the urologist have rather advanced degrees of ptosis, and many of them have pathologic changes in the kidneys as a result of the ptosis These can rarely be relieved by palliative measures, especially if it is necessary for them to engage in manual work A nephropexy is usually more economical and more apt to be successful If the patients can lead a life of leisure and remain regularly under the care of a competent doctor, they often do fairly well with medical treatment When complications, such as aberrant vessels, bands of adhesions, or pathological changes

at the ureteropelvic orifice can be demonstrated, operative treatment is the only means of relief. Indigent patients are rarely in a position to carry out the palliative methods required and should be operated upon when the pathology or symptoms seem sufficient to require treatment. Those who do manual labor or engage in athletic sports are also more apt to obtain relief by surgical means.

Nephrectomy is indicated when nephropexy has failed to relieve incapacitating symptoms, or when the kidney is of no functional value or is the site of malignancy.

NEPHROPEXY

The purpose of nephropexy is to suspend the kidney and to create adhesions that will hold it in place, thereby improving drainage and preventing traction on the vascular pedicle and adjacent organs. The operation is indicated when ptosis of the kidney interferes with drainage, or when there is persistent pain or gastrointestinal disturbance resulting from the excessive mobility. The kidney should also be suspended following plastic operations on the kidney pelvis, or when, during any conservative operation, the kidney has been completely mobilized. Numerous methods of suturing the kidney in place have been devised, any of which may be successful if the kidney is properly prepared and care is taken to suture it in its normal anatomical position. An important part of the operation is complete liberation of the upper ureter and pelvis and careful dissection of all perirenal fat and fascia from the kidney. The ptosed kidney is often complicated by adhesions of the ureter, aberrant vessels or ureteropelvic pathology. When no such complications exist, pronounced degrees of renal mobility are often recognized in which no discomfort is experienced by the patient and the kidney empties normally.

The Operation.—Regardless of the method of suspension to be used, the preparations of the kidney and its bed are the same. Adequate exposure is necessary so that the kidney, the ureter above the pelvic rim, and renal fossa can be easily seen. An ample, curved lumbar incision (Fig. 82) is usually more satisfactory, though in very thin patients with sufficient space between the costal margin and iliac crest the straight incision (Fig. 92) is satisfactory and causes less discomfort during convalescence. After making the incision and ligating all bleeding vessels, the operation is continued by first separating the posterior portion of the perirenal fascia from the lumbar muscles. A longitudinal incision is then made in the fascia about opposite the medial border of the kidney and is extended both upward and downward. A clean incision in the fascia permits it to be reflected forward and preserved intact for use in protecting and supporting the kidney when it has been placed in its bed. The fascia after having been divided is carefully dissected from the kidney and, together with the perirenal fat, is reflected medially, carrying before it the parietal peritoneum. These structures are retracted anteriorly, giving adequate exposure to the kidney and the renal fossa. When adhesions from the perirenal fascia to the kidney are not readily separated by blunt dissection, they should be divided with scissors to prevent tearing the renal fascia. The kidney thus exposed is

held by an assistant while the surgeon separates all adhesions from the lower pole of the kidney, beginning at the convex border and continuing around the lower pole until the ureteropelvic area is reached. Small blood vessels entering the lower pole are ligated and divided If the vessel is large enough to supply an extensive area of the kidney, it should be preserved. While doing a nephropexy, I encountered an artery entering the lower pole of the kidney almost half as large as the principal renal artery. It would permit only about one-third of the kidney to be carried above the costal margin, so the kidney was fixed in that position The patient was entirely relieved. When the ureteropelvic area is reached, the ureter is identified and carefully liberated as far downward as can be done with safety. All adhesions are divided and any kinks or other obstructive lesions are corrected. Adhesions are then separated from the renal pelvis and the ureteropelvic area is examined If there is stenosis of the pelvic orifice or high implantation of the ureter, an appropriate plastic operation should be done. After the lower pole, pelvis and ureter have been freed of adhesions, the assistant retracts the kidney downward, slightly elevating the upper pole while all fat and adhesions are separated from this area and from the vascular pedicle The kidney is now ready to be fixed in place The renal fossa is prepared by removing all fat and fascia from the lumbar muscles well above the costal margin Occasionally, the liver encroaches upon this area and light adhesions must be broken up to permit the kidney to be placed in a sufficiently elevated position

As previously mentioned, numerous operative methods for renal fixation have been devised; in fact, in most of the papers published on the subject, a new operation or a modification is presented. Each method is claimed to give excellent results and in all probability such is the case Any method by which the kidney is held in place until adhesions are formed will usually be successful so far as fixation is concerned Any operation upon the kidney is always followed by rather extensive adhesions. The poor results that follow nephropexy come usually from improper selection of cases, or from faulty technique in which accessory pathological lesions are not corrected, the kidney and ureter are not completely liberated, or the kidney is placed in an incorrect position Probably the most frequent errors are due to failure to appreciate the real cause of the renal pain and also to the insertion of the fixation sutures so that the kidney assumes a position of rotation when the operation is completed

Kelly Nephropexy

The operation devised by Howard A Kelly is frequently employed and gives excellent results. After the kidney has been prepared as described above, three triangular sutures as devised by Brodel are placed in the true capsule on the posterior surface near the external border. The upper suture is inserted at the junction of the upper and middle thirds of the kidney, the lower suture near the lower pole, and the middle suture midway between the two Kelly used white silk which penetrated the kidney about a centimeter in depth. Because of an occasional sinus resulting from silk, No 1 chromic catgut is more satisfactory, and if the sutures are properly placed and tied while the kidney is held in position

it is not necessary to include renal tissue in the suture. In recent years we have used only two suspending sutures in this operation. The first suture is placed at about the junction of the middle and lower thirds of the kidney and the second suture near the lower pole. The first suture is carried above the twelfth rib as far back as it can be conveniently placed and the second is carried through the margin of the quadratus muscle an appropriate distance below the first (Fig 141). After the kidney has been elevated into position and the sutures

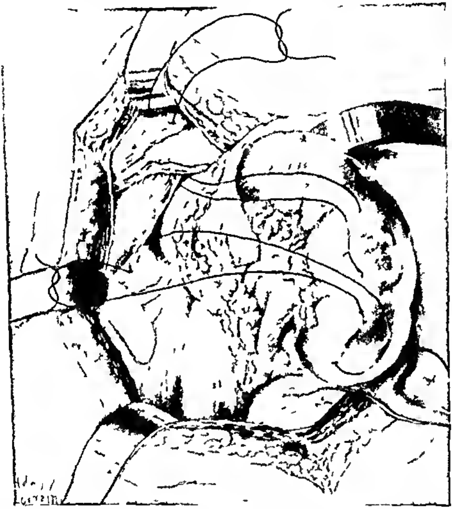

Fig 141.—The author's modification of the Kelly nephropexy. After completely freeing the kidney and upper portion of the ureter two Brödel sutures of No 1 chromic catgut are taken on the convex border of the kidney including only the capsule. The upper suture which is taken just below the midportion of the kidney is carried above the twelfth rib as far posteriorly as possible; the lower suture taken at the lower pole is sutured to the quadratus lumborum at an appropriate distance below. Elimination of the upper suture permits the kidney to be placed higher than in the original Kelly operation. With the use of chromic catgut which includes only the capsule there is no renal injury or danger of sinus.

have been pulled taut, the kidney elevator on the operating table is lowered and the kidney and ureter are examined before the sutures are tied. The upper pole of the kidney should point a little medially and the lower pole outward to insure good drainage of the lower calyces. The ureter should be straight but not taut and there should be no tension on the vessels of the renal pedicle. If all is in good order, the suspending sutures are tied. The perirenal fascia and fat are

Fig 142 —Bilateral nephroptosis History of repeated attacks of pyelitis Film taken in upright position (Dodson J Urol, November, 1943)

Fig 143 —Pyelogram taken thirty days following second operation for bilateral nephroptosis and forty days following first operation Nephropexy on right side Dodson's modification of Kelly's operation on left side by Deming's operation (Dodson J Urol November 1943)

then brought across the lower pole of the kidney and sutured to the lumbar muscles immediately below the kidney. Two sutures are used, one in the psoas muscle about a centimeter external to the ureter and piercing the fascia near the edge of the peritoneum, and the other near the posterior margin of the quadratus lumborum and piercing the fascia about five centimeters from the first suture These sutures are placed beneath the lower pole of the kidney and when they are tied the space beneath the kidney is partly obliterated and the fascia forms a sling beneath the lower pole which gives additional support. A rubber tissue drain is then inserted behind the kidney and the wound is closed in layers as previously described.

Deming Nephropexy

The operation devised by Deming depends entirely upon the perirenal fascia and fat to hold the kidney in place. No sutures are placed in the kidney or its capsule. The perirenal fascia and fat are accurately sutured to the lumbar muscles below the kidney. The following paragraph is abstracted from Deming's description of the operation.

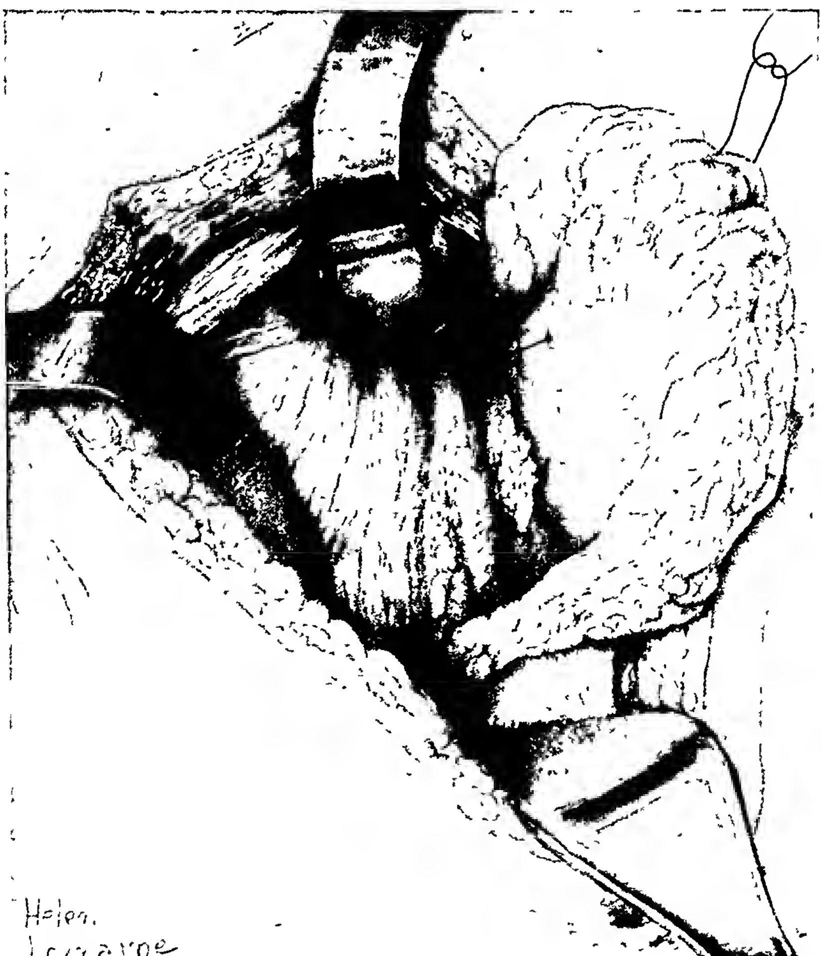

Fig 144—Deming's operation, the kidney has been prepared and is being held in its new bed by a retractor The first suture has been taken near the ureter to suture the perirenal fascia and fat to the quadratus lumborum muscle (Dodson. J Urol, November, 1943.)

"The perirenal fat is all stripped off the kidney which, with its vessels and ureter, is then delivered into the wound It is important that all adhesions be removed from the upper as well as from the lower pole The ureter, which is either tortuous or badly kinked, should be made free Special attention should be noted concerning the kidney fossa—whether shallow, absent or deep The liver sometimes is adherent to the posterior abdominal wall so that it is impossible to place the kidney in its bed without freeing the right lobe The hand should be inserted under the right lobe of the liver to the diaphragm When this is done, the kidney can be replaced sufficiently high to remove all kinks and most of the tortuosities of the ureter The kidney can be made to occupy practically an intrathoracic position with the lower pole lying opposite the last rib The

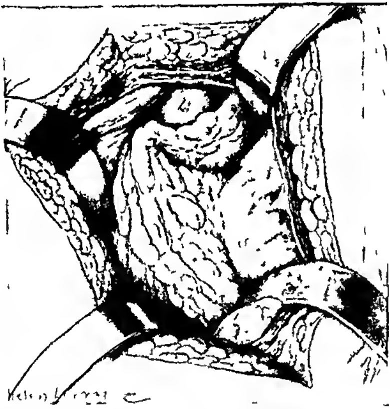

Fig 145 —Four mattress sutures have been placed suturing the fat and fascia to the quadratus lumborum muscle holding the kidney securely in its elevated position (Dodson J Urol November 1943)

upper pole should be carried medially and the lower pole outward to give independent drainage to the lower calyx With the kidney held in position a series of interrupted mattress sutures of No 0 chromic catgut is placed through the perirenal fascia and peritoneum to the quadratus muscle Perirenal fascia is always excessive so that it is easily approximated Precautions must be taken not to include the bowel medially The first stitch should be placed about 1 centimeter from the ureter and as high as possible on the quadratus muscle posteriorly (Fig 144) Care should always be taken not to include any nerves in these sutures of chromic gut A series of five to eight sutures is necessary

then brought across the lower pole of the kidney and sutured to the lumbar muscles immediately below the kidney. Two sutures are used, one in the psoas muscle about a centimeter external to the ureter and piercing the fascia near the edge of the peritoneum, and the other near the posterior margin of the quadratus lumborum and piercing the fascia about five centimeters from the first suture. These sutures are placed beneath the lower pole of the kidney and when they are tied the space beneath the kidney is partly obliterated and the fascia forms a sling beneath the lower pole which gives additional support. A rubber tissue drain is then inserted behind the kidney and the wound is closed in layers as previously described.

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Fig. 141.—Deming's operation; the kidney has been prepared and is being held in its new bed by a retractor. The first suture has been taken near the ureter to suture the perirenal fascia and fat to the quadratus lumborum muscle (Dodson: J Urol, November, 1943.)

Fig 14 —Nephroptosis same patient illustrated in Fig 14F Pyelogram in upright position (Dodson J Urol November 1943)

Fig 146.—Nephroptosis of right kidney, pyelogram made in supine position (Dodson J Urol, November, 1913.)

Fig 147.—Nephroptosis same patient illustrated in Fig 146 Pyelogram in upright position (Dr Lon J Urol November 1943)

to close this aperture These form a basket sling for the kidney so that it is *impossible for the organ to descend (Fig 145).* This row of sutures is now reinforced by bringing up all the extraperitoneal fat and suturing it with two or three mattress sutures to the quadratus muscle below the other line of sutures.

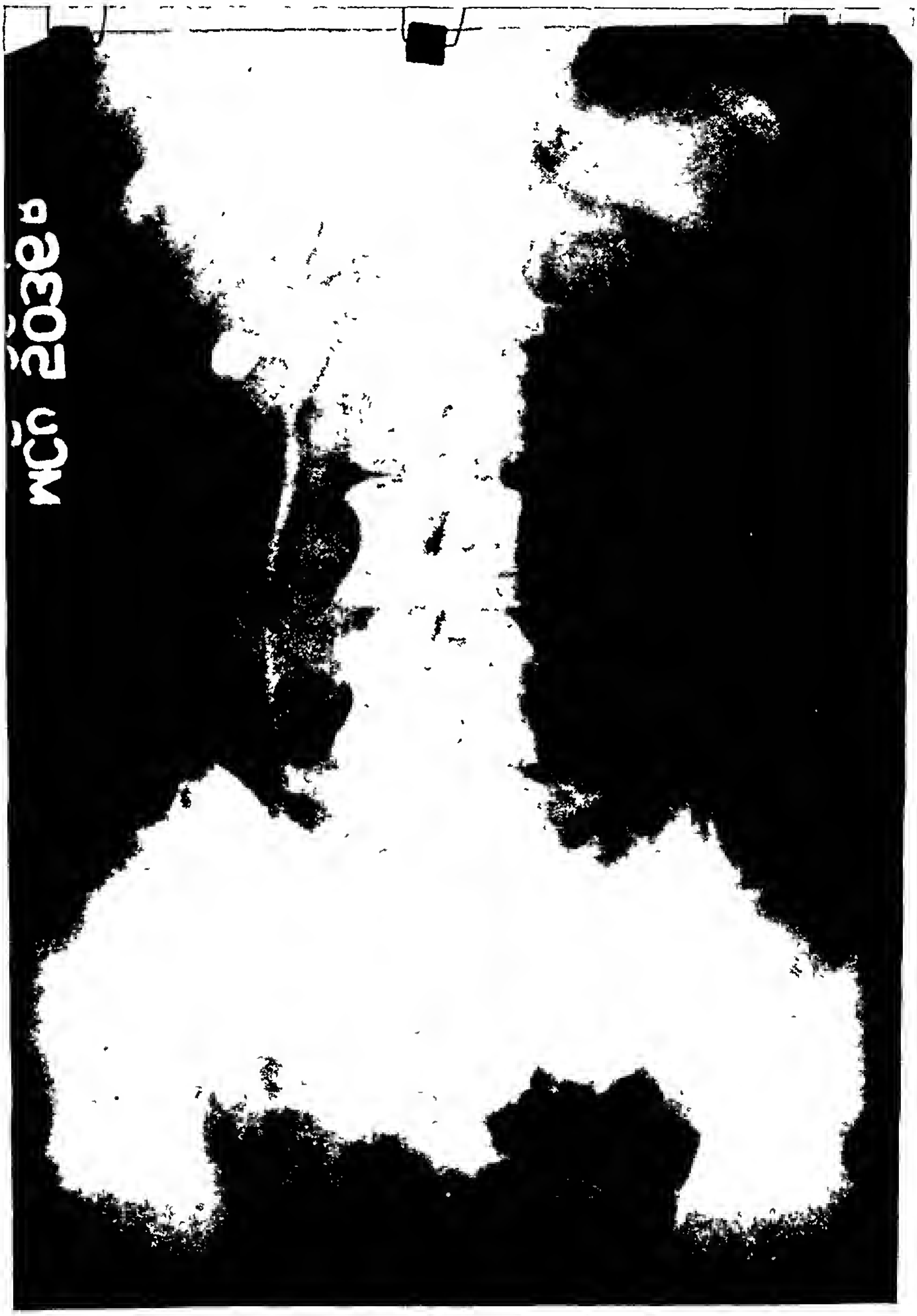

Fig 148—Pyelogram, in upright position, of patient illustrated in Figs. 146 and 147, one year following Deming's nephropexy. (Dodson. J Urol, November, 1943)

This fat acts as a support and fills the space previously occupied by the kidney. The wound is then closed in layers with No. 2 plain catgut and the skin with interrupted silk without drainage."

Deming's operation is probably the most physiological of any so far advised. Neither the kidney nor its fascia is disturbed, and it is held in place, at least in part, by normal support. Adhesions certainly occur between the renal capsule and the kidney bed. The operation has been entirely successful whenever I have tried it. (Figs 146, 147, and 148.) (Figs 149 and 150.)

Many surgeons prefer to strip a portion of the true capsule from the kidney in the belief that it is necessary to approximate the exposed surface of the kidney to the surface of the lumbar muscles to assure permanent fixation. *Among the* earliest operations of this type are those of Edebohl and Albarran.

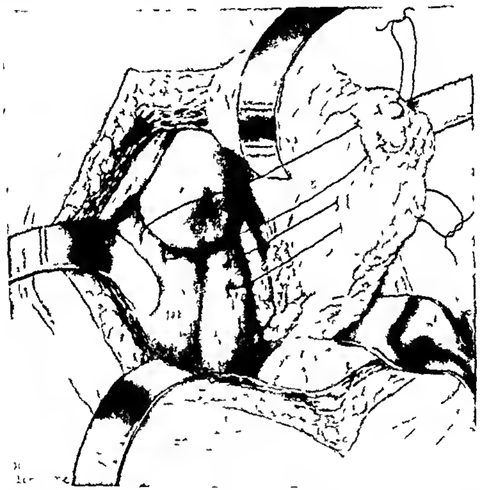

Fig 149.—The author's modification of Deming's nephropexy. One mattress suture is placed near the outer margin of the psoas muscle and the other in the quadratus lumborum. The kidney is not placed quite so high as recommended by Deming. This is a simple and useful routine procedure in the closure of all wounds when the kidney has been freely mobilized for any purpose except *nephrectomy*. *In the treatment* of renal ptosis Deming's original operation is more satisfactory.

Edebohl Nephropexy

The true capsule is split along the external border of the kidney and stripped *toward* the pelvis on both sides for about halfway. Four mattress sutures of No. 1 chromic catgut are placed in the reflected capsule from within outward near the kidney. Two of these sutures are placed on the

anterior surface and two on the posterior surface, the two upper sutures at the junction of the upper and middle thirds of the kidney and the two lower sutures at the junction of the lower and middle thirds These sutures are then passed through the muscle boundaries of the lumbar wound, two in front and two behind The two upper sutures are placed near the upper angle of the wound and the two lower sutures at an appropriate distance below the upper sutures The lumbar wound is closed except for the skin The suspending sutures are then tightened and tied, thereby approximating the raw surface of the kidney to the lumbar wound.

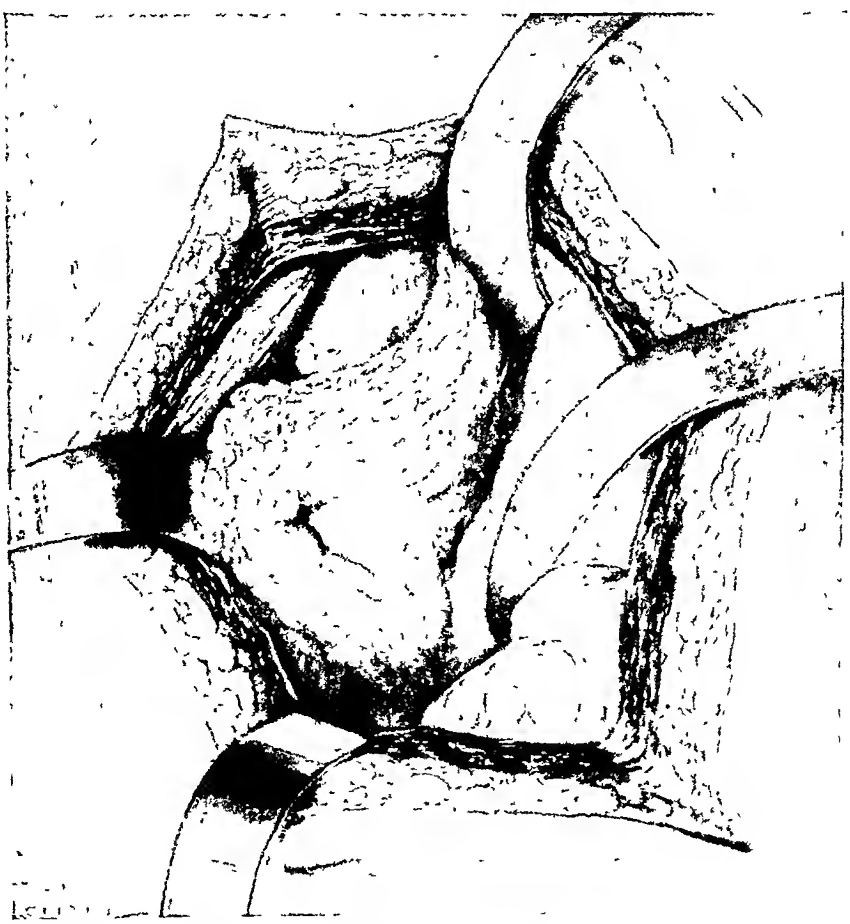

Fig 150—Fascia and fat have been sutured beneath the lower pole of the kidney When the kidney has been freely mobilized this simple procedure will hold it in place and prevent kinking or adhesions at the ureteropelvic area

Albarran Nephropexy

Albarran's operation is similar in principle. The true capsule of the kidney is split and peeled back more than halfway to the hilum on both sides of the kidney. The two halves of the reflected capsule are then split, making four broad flaps Each of these flaps is ligated with No. 2 chromic catgut, tying the ligature near the kidney and leaving the ends long. One end of each of the

ligatures is threaded on a large curved needle. The threaded ligatures of the upper flaps are carried above the twelfth rib as far posteriorly as possible, the needle pierces the eleventh interspace from within outward. As the kidney is held up in position, these ligatures are drawn taut and each is tied to its companion ligature. In a similar manner the lower posterior flap is sutured to the quadratus lumborum muscle and the lower anterior flap is anchored to the anterior muscular margin of the lumbar wound. A drain is inserted and the lumbar wound is closed.

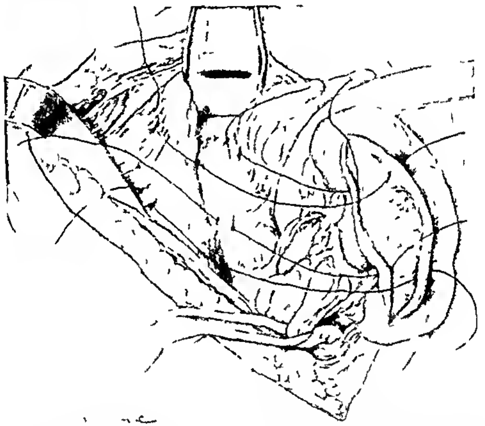

Fig 151.—H. H. Young's nephropexy. The posterior surface of the kidney is exposed by dividing and rolling the capsule in both directions. The rolled capsule is sutured to the inner surface of the lumbar muscles and the exposed posterior surface of the kidney lies against the surface of the muscles.

Young Nephropexy

In Young's method the kidney is freed of investing fat and fascia and rotated forward exposing the posterior surface. A nick is made in the renal fascia midway between the hilum and the outer border. A grooved director is then inserted through this incision and gently pushed beneath the capsule to the upper pole of the kidney. The capsule is divided over the grooved director with a knife. The grooved director is then passed beneath the capsule to the lower pole and the division of the capsule over the posterior surface of the kidney completed. The capsule is carefully freed from the posterior surface

of the kidney and the two freed leaflets are rolled up, one toward the convex border and one toward the hilum, forming two strong tubular masses of fascia with which to anchor the kidney. Heavy chromic catgut sutures are inserted through and around the rolled up bundles of fascia, two to each tube of fascia. The sutures to the inner tube of fascia are sutured to the psoas muscle at a distance of about 2 centimeters from the bodies of the vertebrae and at such a level as to place the kidney in a normal position. The sutures to the outer tube of fascia are sutured to the quadratus muscle opposite those placed in the psoas muscle (Fig. 151). When the four sutures are tied, the decapsulated posterior surface of the kidney is held snugly against the muscles of the back, insuring firm union between the kidney and the lumbar muscles. Gerota's fascia and the perirenal fat are drawn across the anterior surface of the kidney and sutured beneath the lower pole to the lumbar muscles, adding further support to hold the kidney in place.

An operation similar in principle is described by Fish and Hazzard The capsule of the kidney is divided along the upper two-thirds of the kidney and rolled toward the pelvis. Fixation sutures are placed through the rolled edges of the stripped capsule. The kidney is elevated in place and the sutures are passed through and tied to the arcuate ligament.

The method described by Randall and Campbell also depends upon the reflected renal capsule to reinforce the suture bed and partial decapsulation of the kidney to encourage fixation of the kidney by adhesions. After freeing the kidney, including the pelvis and vascular pedicle, of all perirenal fat and fascia, the following procedure is carried out. The upper posterior face of the kidney is decapsulated and the capsule folded downward, so that the two fixation stitches then placed on the posterior face of the lower pole have the added strength of this capsular tissue in preventing their cutting out.

The renal fossa is next prepared by stripping all fat and fascia from the posterior wall, shoving it medianward. Next the kidney is fitted to its new (or old) bed, and the traction stitches are so placed in relation to the lower ribs, the arcuate ligament, or quadratus muscle as to allow a free play to the ureter and a little tilting outward of the lower pole

A number of operations have been devised by which the kidney is suspended with strips of fascia, derived either from the true renal capsule or transplanted fascia.

Vogel Nephropexy

Vogel's method utilizes the true renal capsule. Two strips of the capsule are dissected from the kidney, carried over the twelfth rib, and the ends are drawn down and sutured to the edges of the defect from which the strips were dissected. The kidney is elevated and held in position as the strips of renal fascia are pulled taut and sutured J. Shelton Horsley successfully employed the same principle, using a single, tonguelike flap of fascia dissected from the external margin and adjacent anterior renal surface.

Lowsley Nephropexy

O S Lowsley suspends the kidney with twenty one day chromicized ribbon gut, with an atraumatic needle attached to one end The true capsule is divided along the external border of the kidney and stripped back exposing about one sixth of the kidney Chromic ribbon gut is passed around the upper and lower poles of the kidney through straps made in the renal capsule at suitable intervals (Fig 152) The catgut is tied snugly but not tightly enough to compress the cortical substance The free ends of the upper and lower strands are tied together to help hold the gut in place The ends are left long The needle attached to the upper sling of gut is passed above the twelfth rib as far back as possible and the attached gut is pulled over the twelfth rib, bringing the kidney up in place The attached needle is cut away and this end of ribbon gut is tied to the end that has been tied to the lower strand of gut The needle attached to the strip of gut about the lower pole of the kidney is passed through a portion of the quadratus muscle at an appropriate place, the needle cut away and this end is tied to the end that has been tied to the upper strand After determining that there is no obstruction to the ureter, the lumbar wound is closed without drainage

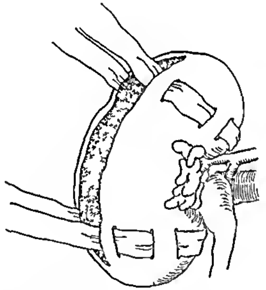

Fig 152—Lowsley's nephropexy The capsule is split along the convex surface and the kidney is surrounded by ribbon gut near the upper and lower poles

Postoperative care The postoperative treatment of nephropexy is rather important The patient should lie on the side operated upon for a few hours immediately following the operation, and should be kept either on that side or on the back ten days before being permitted to lie on the other side The foot of the bed should be elevated about four inches during this time A small pillow may be placed under the head Otherwise, the immediate postoperative treatment is the same as that for other patients who have had an operation upon the kidney At the end of ten days the foot of the bed may be lowered and the patient permitted to lie on either side but he should be kept flat in bed for

another week. A snug abdominal binder is then applied and the patient is permitted to sit up in bed, and the next day in a chair. The patient may return home when strong enough to walk. Strenuous exercise, lifting heavy objects, and long automobile rides should be prohibited for at least two months During this time a snug abdominal binder or support should be worn.

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CHAPTER XI

RENAL CALCULI AND THEIR TREATMENT

Single Stones, Multiple Calculi, Staghorn Calculi, Bilateral Calculi, Calculous Pyonephrosis, Stone in the Kidney and in the Ureter, Pyelolithotomy, Pyelonephrolithotomy, Nephrolithotomy, Heminephrectomy

RENAL CALCULI

The formation and growth of calculi in the kidney lead all other pathological processes in destruction of renal tissue Of the 122 nephrectomies done in the Hospital Division of the Medical College of Virginia from 1930 to 1940, 38 were required because of calculi either growing in the kidney or lodged in the ureter A survey of all the nephrectomies done in the city of Richmond, Virginia, during this period indicates that approximately one third were necessary because of stone During the same period many more operations and cystoscopic procedures were done to rid the kidneys and ureters of stone Renal calculi are formed at all ages but are more prevalent in the period of 30 to 50 years of age At least 50 per cent of the cases occur then Stones in children and the aged are infrequent They are somewhat more common in the male than in the female but the difference is not very great In most of the series of cases reported, stones are found more frequently on the right side and in 10 to 20 per cent of cases the calculi are bilateral Bilateral calculi are usually associated with or caused by infection Multiple calculi, which occur in about 40 per cent of cases, are also frequently associated with infection and in many instances are bilateral

Calculi formed in kidneys that are apparently normal and when no predisposing cause can be found are spoken of as "primary calculi" The chemical composition is predominantly oxalates Urate or uric acid stones are uncommon in the kidney In my experience most cases of uric acid calculi are in children Calculi composed solely of urates or uric acid are usually expelled from the kidney without attaining very great size I was consulted by a patient who has passed numerous ammonium urate stones and only two required catheterization of the ureter to aid them in passing After a period of five years of repeatedly forming stones, his urine was not infected and his kidney function was not impaired Phosphate and carbonate stones are rarely of primary origin Primary stones are not very destructive to renal tissue unless they produce obstruction, they are rarely of great size and do not often recur

Secondary calculi, or those resulting from infection hyperparathyroidism or extended decubitus, are predominantly phosphatic They frequently recur unless the predisposing cause can be removed They often grow to a very large size, are frequently multiple and are quite destructive to renal tissue In recent

years much thought has been given to the etiology of stone and some progress has been made. Recurrence has been prevented and in a few instances stones have disintegrated and have been eliminated from the kidney under appropriate medical treatment Such cases, however, are extremely rare and the stones were probably recently formed and loosely constructed Surgery must remain, at least for the present, the principal treatment for renal calculosis even though only the product of the disease is removed. The surgical treatment is greatly aided by medical measures based on an understanding of the etiological factors concerned in any given case.

The choice of treatment depends upon many factors, such as age and physical condition of the patient, the size, number and location of the stones, the presence or absence of infection, the type of organism causing infection, and the amount of damage that has been done to the renal tissue. Stones resulting from disturbed metabolism or urea-splitting infection require special attention, for in some cases recurrence follows so rapidly upon removal that the operation seems scarcely to be justified. The surgical removal of stones and treatment directed toward the prevention of recurrence must therefore be closely coordinated

Every renal stone is a constant menace to the functional value of the kidney and to the health of its host. It may cause gradual destruction of the kidney by pressure necrosis, by obstruction of the entire kidney at the ureteropelvic junction or by obstructing a portion of the kidney by plugging the orifice of a calyx (Fig. 38). When infection occurs, which is always encouraged by the presence of calculi, renal destruction progresses much more rapidly. It is therefore desirable to remove all renal calculi that are too large to pass out through the ureter. The operation is, of course, rarely an emergency. In some cases a period of preliminary treatment is desirable before the stone is removed and in others surgical treatment must be postponed or abandoned because of complicating factors

Single Stones.—Stones apparently small enough to pass through the ureter, those a half centimeter or less in the largest dimension, should be treated by palliative measures unless they are blocking the kidney pelvis or a calyx They are often difficult to find at operation and efforts to remove them may cause more damage than benefit. It is important to warn the patient of their presence and their danger Occasionally such stones can be made to pass by dilating the ureter and irrigating the kidney pelvis The patient should be urged to drink large quantities of water. The growth of the stone should be checked by x-ray examination at least at twelve-month intervals. Stones vary greatly in their rate of growth Joly states that when a stone ceases to grow it indicates a decline in the function of the kidney. This is not always true. Stones occasionally remain almost stationary for several years in kidneys with normal function. In most cases even oxalate stones will show definite increase in size in a period of a year, while phosphatic stones may entirely fill the kidney pelvis in a much shorter period. If the small stone is accompanied by infection, very careful ob-

servation should be maintained Appropriate urinary antiseptics are given and the urine is kept acid, unless the stone is believed to be composed of uric acid or cystine Medical treatment will be more fully discussed under postoperative care

Stones too large to pass through the ureter should be removed by appropriate operation unless the condition of the patient is such that operation will impose too great a hazard Solitary stones growing in the presence of acid urine with little or no evidence of infection are the most favorable cases for operation Recovery is usually prompt, renal function is not impaired but is frequently improved and recurrence is unusual

Multiple Calculi —Multiple calculi are a much more serious problem (Fig 153) They are usually accompanied by or caused by infection and not infrequently are bilateral Cystine stones and those resulting from hyperparathyroidism are usually multiple and bilateral Small multiple calculi that may

Fig 153 —Multiple renal calculi Note stricture at the ureteropelvic junction which probably caused dilatation of the renal pelvis and retention of stones

possibly pass through the ureter should be treated by nonoperative methods If at least one of the stones is too large to pass operation should be done It is important to determine as accurately as possible the number of stones present so that they may all be accounted for at operation Frequently in such cases one large stone will partly block the kidney pelvis while smaller stones are in dilated calyces There is often sufficient dilatation of the kidney pelvis to permit thorough exploration of all the calyces If there is much infection and the other kidney is normal, nephrectomy is preferable in most dilated kidneys containing multiple calculi if the function is greatly impaired One or more stones are often overlooked and true recurrences are not unusual Furthermore in a kidney with diminished function the infection is usually progressive This is particularly true if the bacteria are of the type that produces alkaline urine

Staghorn Calculi.—Calculi that fill the pelvis and extend into the calyces present an extremely difficult problem (Fig. 154). They are with few exceptions phosphatic and usually are caused by urea-splitting organisms. When removed they recur in an extremely high percentage of cases. They often give few symptoms and in many cases are not recognized until the kidney is severely damaged. The choice of treatment depends upon the age of the patient and the condition of the opposite kidney In elderly patients there is no excuse for operation unless it is required because of pain or pyonephrosis. In such cases it is usually better to remove the affected kidney if the other kidney is free from stone and shows good function; otherwise a nephrostomy should be performed and as much of the stone removed as can be done safely. The nephrostomy tube should be irrigated at frequent intervals by a nonirritating acid solution. Suby's "Solution G" is quite satisfactory. The nephrostomy tube should not be removed until it has been shown that the kidney will drain satisfactorily through the ureter. In elderly people these stones often grow rather slowly and the infecting bacteria, although present on culture, seem not to be very active. I observed one patient who had had bilateral branching calculi for ten years During this time the size of the stones trebled and his renal function diminished from 40 per cent to a mere trace of phenolsulfonphthalein; yet he remained quite active at 74 years of age. At first, efforts were made to acidify the urine and various urinary antiseptics were given, all without the slightest effect.

Fig 154—Staghorn calculus

In young and middle-aged patients suffering with staghorn stones surgical treatment is preferred. If the opposite kidney is free from infection and has good function, nephrectomy should be done if the kidney is greatly impaired. If the stone is removed, small fragments are frequently left behind, recurrence is the rule and the opposite kidney may become infected. If by preliminary treat-

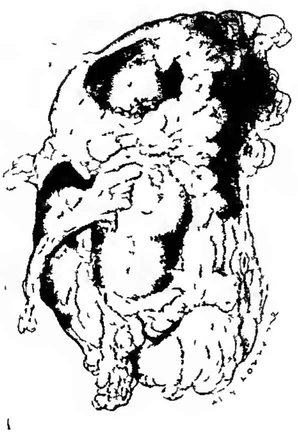

Fig 155—External view of pyonephrotic kidney containing stones

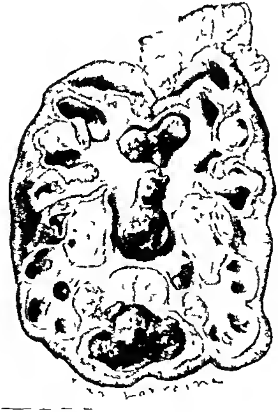

Fig 156—Same kidney as illustrated in Fig 155 The kidney is divided showing obstructing renal calculi

Staghorn Calculi.—Calculi that fill the pelvis and extend into the calyces present an extremely difficult problem (Fig. 154). They are with few exceptions phosphatic and usually are caused by urea-splitting organisms. When removed they recur in an extremely high percentage of cases. They often give few symptoms and in many cases are not recognized until the kidney is severely damaged. The choice of treatment depends upon the age of the patient and the condition of the opposite kidney. In elderly patients there is no excuse for operation unless it is required because of pain or pyonephrosis. In such cases it is usually better to remove the affected kidney if the other kidney is free from stone and shows good function; otherwise a nephrostomy should be performed and as much of the stone removed as can be done safely. The nephrostomy tube should be irrigated at frequent intervals by a nonirritating acid solution. Suby's "Solution G" is quite satisfactory The nephrostomy tube should not be removed until it has been shown that the kidney will drain satis-

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In young and middle-aged patients suffering with staghorn stones surgical treatment is preferred. If the opposite kidney is free from infection and has good function, nephrectomy should be done if the kidney is greatly impaired. If the stone is removed, small fragments are frequently left behind, recurrence is the rule and the opposite kidney may become infected. If by preliminary treat-

Calculous Pyonephrosis—When the kidney pelvis or calyces are partly or completely occluded by calculi, purulent urine is frequently retained. The amount varies from a few cubic centimeters to a pint or more and the character of the fluid varies from a definite cloudiness of the urine to thick pus. Such kidneys are either severely damaged or entirely destroyed and when there is a

Fig 157—Large staghorn stone of right kidney. Two stones in left ureter. The left kidney was entirely destroyed, the right kidney had fair function.

normal kidney on the other side, nephrectomy is usually advisable (Figs 155 and 156). If the opposite kidney contains a stone or is otherwise diseased, a more conservative operation should be tried. Remarkable improvement is possible with the removal of the stone and the establishment of adequate drainage, provided the renal parenchyma has not already been entirely destroyed. The re

ment the infection can be controlled and the urine made acid, an effort may be made to save the kidney if it still retains a fair degree of function. Bilateral branching calculi should be removed and treatment instituted to prevent their recurrence. If the operations are done carefully, using an extended pelvic incision or a pelvic incision with small incisions over individual dilated calyces, there will be very little damage to the kidney tissue and improvement in function regularly occurs. The kidneys should be operated upon one at a time but with as short an interval between operations as is possible with reasonable safety. There will be recurrences in many cases but, even in those, destruction of the kidney will be greatly delayed.

Bilateral Calculi.—Stones are found in both kidneys in about 12 per cent of cases of calculi. They are usually infected and frequently of the staghorn variety. Calculi resulting from hyperparathyroid disease and those occurring in patients who must remain recumbent for long periods of time are often bilateral. Usually the stone in one kidney is much larger than the stone in the opposite kidney and in most cases the symptoms are confined to one kidney, although there may be a history of a previous attack of pain on the other side. Bilateral stones are a serious menace because of progressive renal damage and the constant danger of anuria. In most cases bilateral operation should be advised. Elderly patients with stones which are not obstructing the kidneys may live many years in reasonable comfort. Operation should not be advised in such cases except for the relief of obstruction. Very small stones may be treated by medical means with the hope that they will pass. In early or middle life, when both kidneys contain stones too large to pass through the ureter, operation for their removal should be advised, for there are more need for preserving renal function and a greater probability of improvement of function when the stones are removed. It is usually considered advisable to operate upon the kidney with the least involvement first. This is good practice when the operation can be done in a quiescent period and when there is some function on the more diseased side. The function remaining in the more diseased kidney may be utilized following the operation on the better kidney. When the patient has recovered from the first operation, the functional value of the kidneys can again be determined and the more diseased kidney can be operated upon by removing the stone or by nephrectomy, according to indications. As a rule, if there is any impairment in the function of the first kidney operated upon, the remaining kidney should be treated conservatively. When the patient is seen during an acute attack, the kidney that is involved should receive first attention. The same is true of the kidney that is completely obstructed or pyonephrotic. When conditions require that the more diseased kidney be operated upon, nephrectomy should not be done unless the kidney is entirely destroyed. A greatly diseased kidney will usually improve by nephrostomy drainage. The tube should be left in place until the stone has been removed from the better kidney. After the better kidney has recovered its maximum function, the other kidney can be removed if it is apt to be a menace to the patient's health.

preference of the surgeon. It is important that adequate space be provided. Much time is consumed and at times unnecessary trauma is done to the kidney by attempting to remove a renal calculus without adequate exposure.

Delivery of the Kidney.—It is not always necessary or desirable to liberate the kidney completely in order to remove a stone. A stone easily palpable in the pelvis or situated in a lower calyx frequently can be removed by freeing only the lower half of the kidney, leaving the attachments to the upper pole undisturbed. Certainly unless some plastic procedure is to be carried out for the improvement of drainage, or the position of the kidney can be improved by nephropexy, there is no occasion to free the kidney more than is necessary to expose the stone (Fig. 158).

Fig. 158.—Exposure of posterior surface of renal pelvis for the removal of a small stone. The kidney, only partly liberated, is pulled toward the midline, exposing the posterior surface of the pelvis.

The most satisfactory method of freeing the kidney is to separate the perirenal fascia posteriorly from the quadratus lumborum and psoas muscles and incise it throughout its length posterior to the kidney. The anterior flap of

moval of stones from severely infected kidneys is not always successful and the prolonged drainage that is necessary if such kidneys are to be preserved requires lengthy hospitalization If the opposite kidney, although impaired, is capable of sustaining life, it is sometimes best for economic reasons to do the operation that promises the quickest recovery. In elderly or debilitated patients it is often necessary to do a preliminary nephrostomy before removing a pyonephrotic kidney The preliminary operation may be done under local anesthesia and any stones that are easily reached are removed at the time If sufficient improvement occurs, nephrectomy may be done, otherwise the nephrostomy drainage is continued When the function of the kidney has been destroyed, there is but slight drainage from the tube and very little inconvenience results.

When an elderly person has a kidney that has been destroyed by stones and infection and when the only symptom is pyuria, operation is not necessary. The advantages to be gained are not worth the risk

Stone in the Kidney and Ureter.—When there is a stone in one kidney and a stone in the opposite ureter there is no question of the proper procedure (Fig 157). The stone causing obstruction should be removed first. This is usually the one lodged in the ureter. When there is a stone in the kidney and one in the ureter on the same side, it is sometimes more difficult to decide where to operate first. The decision depends to a great extent upon the size and location of the stones If the stone in the kidney is small and particularly when located in a calyx, it should be disregarded and the ureteral stone removed, either by cystoscopic manipulation or by operation If the stone in the kidney is too large to pass through the ureter and the stone in the ureter is of such a size that there is a good probability that it will pass, it has been my practice to remove the renal stone and drain the kidney. Without exception the ureteral stone has passed painlessly during convalescence. A calculus lodged in the ureter and too large to pass should be removed first. In a few cases I have removed a stone from the upper half of the ureter with a Howard stone remover passed through an incision in the kidney pelvis through which the renal stone had been removed

OPERATIONS FOR RENAL CALCULI

The surgical treatment of renal calculi varies according to the size and number of the stones, the presence and character of the infection, and the amount of damage the kidney has suffered. In suitable cases stones are removed through an incision in the renal pelvis, through an incision in the parenchyma, or a combination of the two. When the kidney is destroyed or so badly damaged that it is of little functional value and an actual or potential menace to the patient's health, nephrectomy is indicated. Occasionally, because of advanced bilateral disease or stones producing obstruction and pyonephrosis of an only kidney, it may be necessary to resort to nephrostomy as a lifesaving measure and remove only such stones as are easily accessible

The kidney may be exposed through either of the lumbar incisions previously described on pages 136-148, depending upon the build of the patient and the

very deep, as in very stout patients, the wound must be widely retracted and the operation carried out without delivering the kidney. Sometimes when the kidney is enlarged by pyonephrosis or hydronephrosis, it is necessary to divide the pedicle before delivering the kidney. The method of accomplishing this will be discussed under nephrectomy.

Pyelolithotomy

Most stones can be removed through an incision in the kidney pelvis. The incision is usually made in the posterior surface of the pelvis to avoid the blood vessels which are in relation to the anterior surface. If the kidney can be delivered into the wound, the operation is much less difficult. The posterior surface of the pelvis is then exposed by turning the kidney forward where it is held

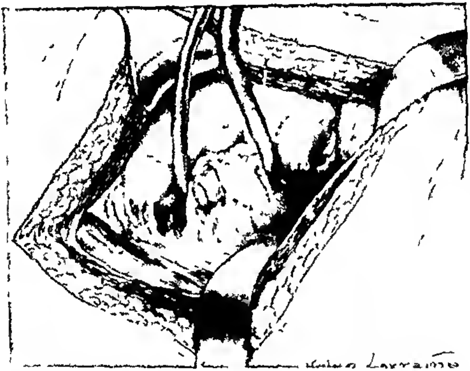

Fig 159.—Method described by Randall for exposing the posterior surface of the renal pelvis in stout patients when it is *impossible to deliver the kidney*. A soft rubber tube is placed around the renal pedicle and pelvis. By pulling upon the tube and tilting the kidney medially the posterior surface of the pelvis is exposed. An otherwise difficult exposure is made quite easy by this procedure. The posterior surface of the pelvis can be readily incised and the stones removed.

by an assistant. A layer of gauze placed around the kidney *will prevent its* slipping from the assistant's hand. If the kidney cannot be delivered into the wound the operation must be done within the kidney *fossa*. *Randall* described a very excellent method of exposing the posterior surface of the pelvis when the kidney cannot be delivered. The *following is* his description of the procedure. "Once the kidney is freed and the *ureter identified*, a rubber tube or catheter (20 22 F.) is slipped about the pedicle vessels *and* under the ureter with the free ends brought out behind the kidney. *The* kidney is gently pushed

fascia is now reflected medially, carrying with it as much of the perirenal fat as will adhere to the fascia. As this fascia and fat are freed from the kidney and pushed toward the front, they carry with them and protect the peritoneum, and the fat and fascia are preserved intact to be used as a protective covering for the kidney when the wound is closed. In most cases the perirenal fat adheres very lightly to the kidney and is easily separated by the finger or a sponge. If there has been much perinephritis, the fat will be dense and infiltrated with fibrous tissue, the adhesions will extend from the perirenal fascia to the kidney, and the sclerotic fat will be densely adherent and difficult to strip from the kidney. It is important when separating such dense adhesions to avoid if possible any injury to the true capsule of the kidney. When once torn it is readily stripped from the entire kidney, and this greatly increases the difficulty of the operation.

When the perirenal fascia and fat have been stripped from the kidney and retracted medially, the anterior and posterior surfaces of the kidney are exposed by separating the adherent fatty and cellular tissue with the finger or a sponge The kidney is then grasped with one hand while the adhesions are separated from the lower pole. At the extremities of the kidney the adhesions are always more dense and to this difficulty are frequently added small aberrant blood vessels Before they are divided, the adhesions about the poles of the kidney should be gently grasped between the finger and thumb; if pulsation is felt, the artery should be investigated. If the vessel is thought to supply a large part of the kidney, it should be isolated and preserved. If the adhesions are very dense, they should be divided with scissors to prevent tearing the true capsule Adhesions to the lower margin of the lower pole of the kidney should be examined to be sure the ureter is not bound to the kidney On one occasion I divided the ureter which was greatly displaced by adhesions to the lower pole of the kidney. When the region of the ureter is reached, it is well to isolate the ureter before completing the dissection in this area. After freeing the lower pole of the kidney, it is sometimes possible to have the assistant elevate the lower pole and rotate the kidney forward while the posterior surface of the renal pelvis is exposed and the stone removed. The incision in the pelvis is then sutured and the kidney is returned to its bed without liberating the upper pole. This is often possible in thin patients The same limited exposure is also sometimes possible when removing through the cortex stones located in a lower calyx. If adequate exposure requires complete liberation of the kidney, the lower pole is dropped back into the wound after it is freed of adhesions and the adhesions are separated from the upper pole. Small vessels often enter the upper pole of the kidney and when divided retract from view. It is, therefore, advisable to clamp the adhesive bands to the upper pole of the kidney with a hemostat and, after dividing them between the hemostat and the kidney, to ligate the clamped tissue. In this way troublesome bleeding is avoided. When the kidney has been liberated to the pedicle on all sides, it can be delivered easily from the wound in thin patients or when the pedicle is long. When the pedicle is short or the wound is

the pelvis it is incised in the general axis of the ureter The incision should not be carried too close to the kidney substance because large vessels may be injured and it is difficult to suture this region satisfactorily, and injury of these vessels may cause atrophy of a portion of the renal parenchyma A suture of fine plain catgut is placed in each lip of the wound in the pelvis and the ends are left long to act as tractor sutures (Fig 160) The incision is extended until it is large enough to permit exploration of the pelvis and extraction of the stone The stone is caught with forceps made for that purpose and should be handled gently to prevent crushing it When the kidney pelvis is very short, it is sometimes better to make a transverse incision in the pelvis and thereby obtain more working space without extending the incision too near the ureter When this is done the posterior margin of the renal sinus is retracted upward, including the retropelvic vessels, and the transverse incision is made as high as possible (Fig 161) The upper margin of the incision should be transfixed with a small plain catgut suture so that it will not retract from view and cause difficulty in closing the wound The incision may extend the entire width of the pelvis and gives ex-

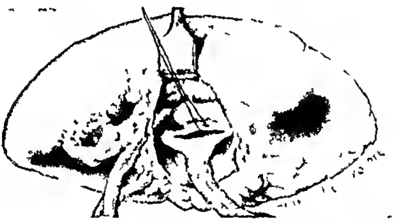

Fig 161—Transverse incision of the renal pelvis for removal of stones when the pelvis is extremely small The posterior lip of renal tissue is retracted upward and a transverse incision is made near the upper margin of the pelvis The upper lip of the incision is caught with a suture to keep it *from retracting beyond reach*

cellent access to the interior of the kidney in suitable cases When the stone is too large to be brought through the pyelotomy opening, the wound may be enlarged through the renal parenchyma in line of the lower calyx, according to the method of Marion The retropelvic vessels should be transfixed by two interrupted sutures passed through the edges of the renal sinus about one half centimeter apart and the incision made between them The incision is carried only far enough through the parenchyma of the kidney to permit removal of the stone (Fig 164) When the stone has been removed the wound in the kidney is closed with interrupted sutures of No 1 plain catgut In most cases the fact that a stone is too large to be removed through the kidney pelvis is recognized during the examination and the proper operative procedure is decided upon

forward so that its convex border rolls over toward the relaxed and roomy peritoneal cavity. At the same time slight traction on the rubber tube brings the pedicle mass up toward the opening of the wound, and the pelvis becomes uppermost with the kidney mass completely undelivered. The result is that the portion on which one desires to work is directly before the operator, and at times just within the skin incision. Little or no wound retraction is required, and one can gently and completely dissect out the upper end of the ureter, the ureteropelvic junction, the complete pelvis, and renal sinus. Any existing ob-

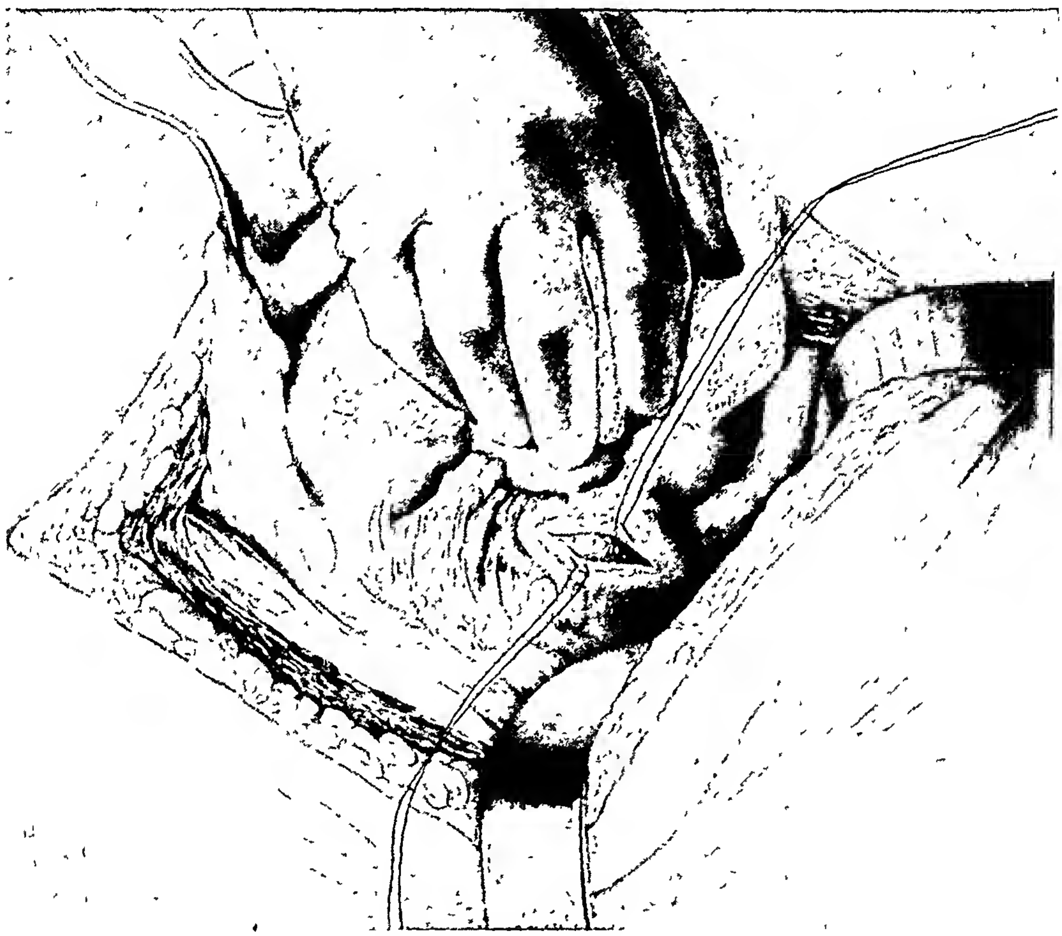

Fig 160 —Stone impacted at the ureteropelvic junction The kidney, partly liberated, held medially, exposing the ureteropelvic area

structive pathology can be completely exposed, studied and corrected, and, when ready, the pyelotomy is performed at the chosen point and the calculus extracted with the maximum of ease and the minimum of trauma" (Fig. 159.)

After the posterior surface of the pelvis has been exposed, the adherent fat is incised and dissected back on each side If possible, the fat should be preserved to suture over the wound when the pelvis is closed. Before opening the pelvis the tissues around the kidney are thoroughly protected with gauze in order to prevent soiling the wound with the escaping urine. After exposing

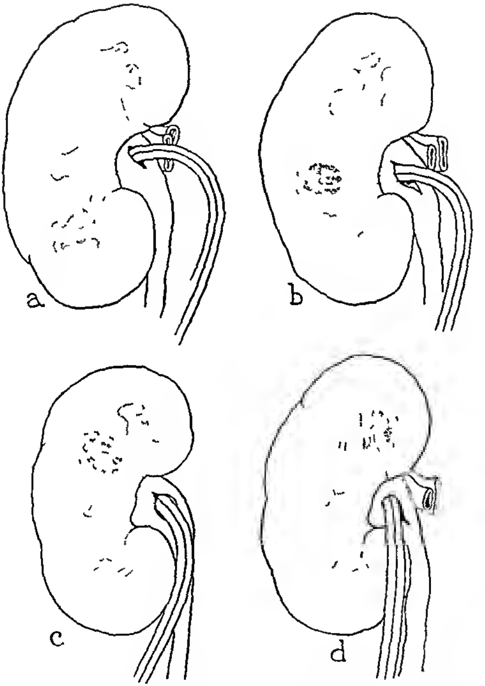

Fig 169—Randall's forceps for removal of stones from the renal calyces The set of four forceps each with a different curve admits exploration of the entire renal pelvis

X-ray equipment at the operating table for the purpose of examining the kidney with the fluoroscope or of taking pictures of the exposed kidney is helpful in removing fragments or multiple stones.

If fragments are left behind they may form a nucleus for another stone, so it is important to remove the calculus intact After extracting the stone the pelvis is explored with the little finger or a small blunt probe, if the opening is too small to admit the index finger, but the exploration should be as gentle as possible because the finger can easily rupture veins about the calyces that will cause considerable hemorrhage. If the pyelogram indicates that the pelvis and calyces are not dilated, exploration with the finger may be more injurious than beneficial.

Occasionally, a small stone found in the pelvis on examination will have slipped into a calyx at the time of operation, or one or more smaller stones may be in a calyx with a larger one in the pelvis Such stones may be very troublesome, especially when exposure is difficult. If the calyces are dilated, small stones may be made to gravitate to the pelvis by suturing the wound in the pelvis snugly around a catheter and distending the pelvis and calyces with water. The kidney is held so that the pelvis is the most dependent part and is gently shaken. The fluid is then rapidly withdrawn through the catheter, frequently bringing small stones to the pelvis The procedure may be repeated until the stones can be felt through the wall of the pelvis, or until the procedure has been proved to be unsuccessful.

The forceps designed by Alexander Randall are very useful in removing stones from the calyces (Fig. 162).

It is usually unwise to attempt to remove through the pelvis a stone that is impacted or fits the calyx snugly, unless a portion projects sufficiently into the pelvis to be grasped In most cases if the stone has disappeared within a calyx that is not dilated, efforts to remove it through the pelvis merely serve to push it further in and lacerate the parenchyma of the kidney. A pyelotomy is very helpful in such cases by permitting exploration within the pelvis and at times by permitting pressure to be made against the stone to hold it in position while it is being removed through the parenchyma. If there is room in the pelvis, the little finger should be inserted and orifices of the calyces gently explored while pressure is made against the overlying surface of the kidney If the stone can be felt, the finger blocking the calyx should be held in place and the parenchyma overlying the stone incised and the stone removed (Fig 163) If the stone cannot be felt between the fingers, the calyces are explored with a small probe If the stone can be definitely identified, the probe is held in contact with it until the kidney is incised and the stone is removed Once contact with the stone is lost, it may not be so easy to find again A small stone, especially when covered with blood, is very elusive In a number of cases in which the stone could not be palpated or felt with a probe, I have successfully used a small straight needle to explore the parenchyma of the kidney. When contact is made the needle is held in place and an incision is made to the stone. If an x-ray unit

catheter and tied around the probe (Fig 127) The probe is then withdrawn pulling the tip of the catheter into the kidney pelvis The tip should rest well within the pelvis but not far enough down to occlude the ureter It is fastened in position by a mattress suture of fine catgut which passes through the capsule of the kidney and then through the wall of the catheter (Fig 128) If the pyelotomy has been combined with nephrotomy, there is less danger of secondary hemorrhage if the nephrotomy wound is sutured tight and the drainage tube brought through an uninjured area The incision into the pelvis is closed by a continuous suture of fine plain catgut The fat and fascia which were dissected from the pelvis are brought together over the suture line and fastened with a few interrupted catgut sutures The packing is removed and a small cigarette drain is carried down to near the pelvis of the kidney to conduct away any urine if there happens to be leakage Both the cigarette drain and the catheter are brought out at the upper portion of the wound and the wound is closed in the usual manner The catheter is connected to a bottle to prevent soiling of the dressing and if there is much infection in the kidney the catheter is kept in position two or three weeks for the purpose of irrigation and instilling antiseptic solutions The catheter should be kept attached to a sterile tube and the receptacle for the urine should be washed and sterilized daily It is also important to irrigate the pelvis with ½ per cent phosphoric or acetic acid if the urine is alkaline to prevent incrustations which may break off and form nuclei for other stones If the kidney is drained because of trauma, the tube should be removed when the urine is clear

Pyelonephrolithotomy

Attention has been called previously to the advantage of combining an incision in the pelvis with one in the cortex This procedure is of definite value when a stone disappears into a calyx or when there is a stone in the pelvis and one in a calyx, especially when the orifice of the calyx is too small to permit the stone to be grasped with forceps and drawn into the pelvis without lacerating the kidney The operation is carried out by first opening the pelvis posteriorly and removing any stones that are free in the pelvis A finger or probe is then inserted and pressure is made against the stone or against the mouth of the calyx containing the stone while the parenchyma is incised and the stone removed (Fig 163) The wound in the parenchyma is closed with interrupted sutures of No 1 plain catgut and that in the pelvis is closed with a continuous suture of 00 plain catgut If the kidney is to be drained, the tube may be inserted through the cortical wound or through an uninvolved calyx

Staghorn calculi may be removed by combined incisions in the pelvis and cortex with but little damage to the kidney The method used by Walters is very satisfactory He makes a V incision in the renal pelvis and retracts the posterior margin of the parenchyma upward, exposing the interior of the kidney The portion of the stone that occupies the pelvis is removed Fragments in the calyces are then removed through a short incision over each calyx, using a finger

is available in the operating room, it is very helpful in such cases. The incision should be only large enough to permit the stone to be removed and should be promptly closed with interrupted sutures of No. 1 plain catgut.

The next step of the operation depends on whether the pelvis of the kidney is to be drained. If there is no active infection and the stone has been removed without injuring the kidney, drainage is unnecessary. There is some evidence that kidneys may become infected through drainage tubes, therefore, drainage of the kidney should be reserved for those cases in which it is clearly indicated. If the kidney is actively infected or if there has been sufficient trauma of the kidney to cause continuous oozing of blood into the pelvis, drainage should be

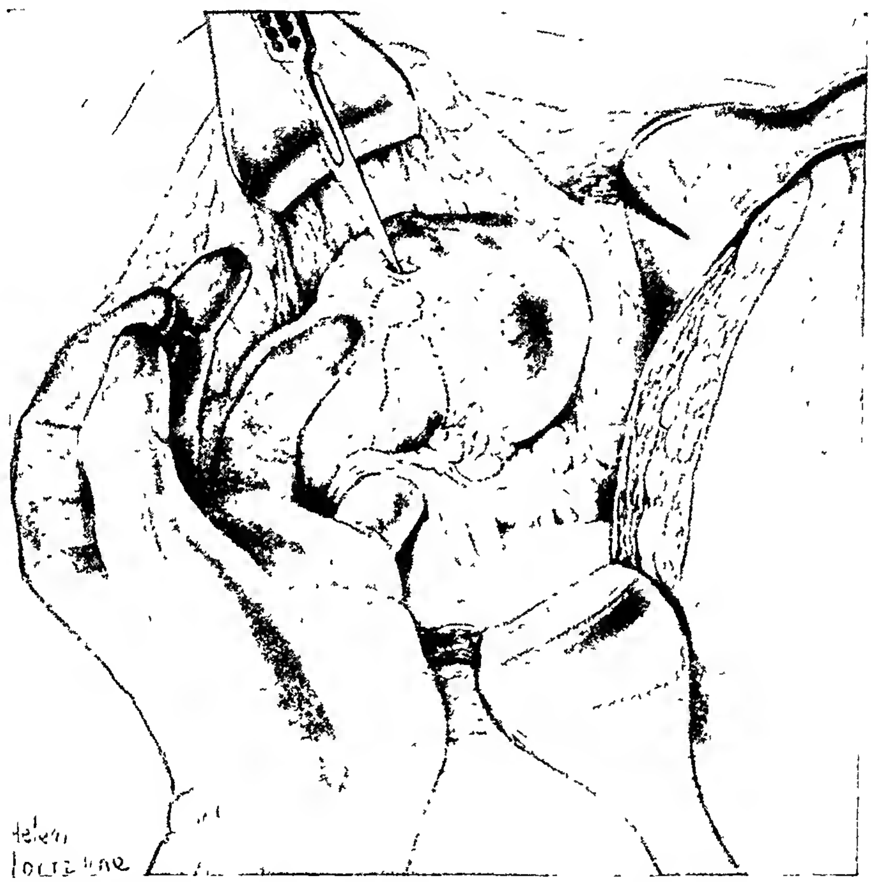

Fig. 163.—Removal of small stone impacted in a renal calyx. The little finger is inserted through a pyelotomy incision and placed against the stone to hold it in place. A small incision is made through the cortex directly over the stone and the stone is removed. If drainage is desired, a nephrostomy tube may be inserted through this opening, otherwise the incision is closed with a single interrupted suture of No. 1 plain catgut.

used. Drainage of the pelvis of the kidney is best provided by inserting a small blunt pedicle forceps through the wound in the pelvis and thrusting it up through a lower calyx, where it is shoved through the cortex. A new soft rubber catheter with one or two additional perforations cut near the end is caught and the tip of the catheter is drawn through into the pelvis of the kidney (Figs. 125 and 126). When the kidney cannot be delivered it is often difficult to insert a forceps. A uterine probe bent at right angle may be inserted through the pelvis and thrust through the kidney. A suture is passed through the tip of the

nutrition of the kidney. It is Joly's opinion that the incision should not be made if the vessel is large enough to be felt pulsating when the posterior lip of the sinus is palpated. I have used this incision with excellent results. After the stone is removed, a small tube is inserted, the posterior vessels are ligated, and the incision is closed, using interrupted sutures of plain catgut in the cortex and a continuous suture in the pelvis.

Inferior pyelonephrolithotomy, as suggested by Zuckerkandl, has lately been reviewed by Papin and by Zondek independently. In this operation, after the kidney is freed, the lower pole is lifted upward and an incision is made along the lower border of the pelvis. When the incision reaches the renal sinus, it is continued through the kidney substance, along its inner border to the lower pole (Fig. 165). The inferior border of the pelvis and the lower calyx are opened; this gives ample space for the removal of rather large stones and for exploration of the pelvis and calyces (Fig. 166). It is particularly useful in the removal of large triangular stones which do not project into the calyces. Bleeding is relatively slight. The wound is closed as in the above mentioned procedure.

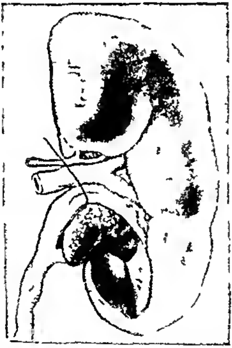

Fig. 166.—Curved incision for enlarging the wound in the pelvis by opening the lower calyx on the posterior surface of the kidney. The wound is closed as in Fig. 197.

Nephrolithotomy

The complete nephrotomies of former years are rarely used at the present time. They were frequently employed when methods of diagnosis were inadequate and the surgeon considered a thorough exploration of the kidney necessary. Furthermore, before a thorough appraisal of the functional value of both kidneys was possible, stones were often removed where nephrectomy would now

within the pelvis to locate and make pressure on the individual fragments. The nephrotomy incisions are closed with interrupted sutures of plain catgut. A drainage tube is inserted through a lower calyx and the wound in the pelvis is sutured. The cortex over the calices is usually thinned and fibrotic, therefore there is little injury to excreting tissue I have found this a very satisfactory method of removing staghorn stones. In one case so treated, although a small fragment was left in a lower calyx, the function of the kidney had more than doubled in twelve months and the fragment left had not increased in size.

Joly described two methods of extending the incision from the pelvis into the renal cortex when the ordinary pelvic incision is too small. He credits Marion with enlarging the opening by continuing the posterior pelvic incision into the cortex. The incision begins on the posterior surface of the pelvis near

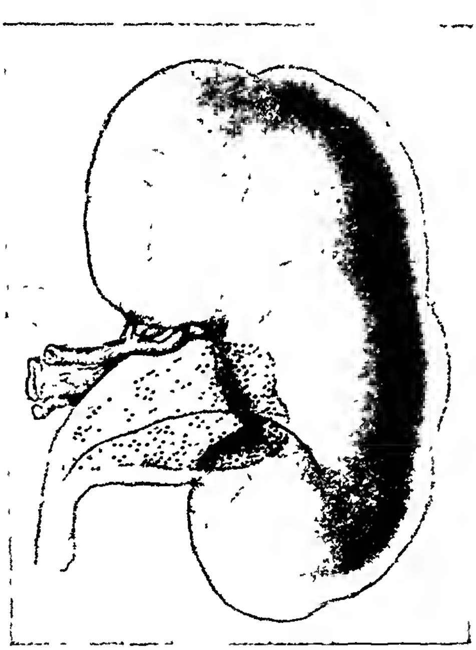

Fig 164

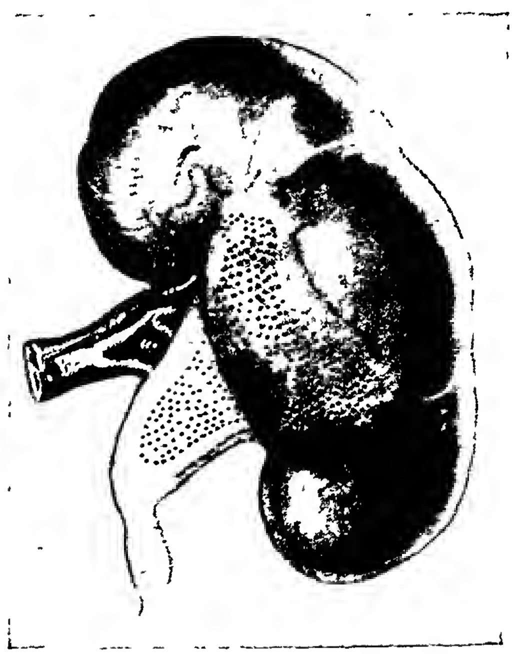

Fig. 165.

Fig 164 —The enlarged wound which is made through a relatively nonvascular portion of the kidney gives adequate room for the removal of large stones from the kidney pelvis The wound in the kidney is closed with interrupted sutures of No. 1 chromic or plain catgut and the wound in the pelvis with a finer suture of the same material

Fig 165 —Dotted line indicates extension of the incision in the pelvis through the cortex, opening the lower calyx of the kidney

the ureteral junction and curves upward toward the junction of the middle and lower thirds of the renal notch. Two clamps are then placed on the edges of the renal sinus to control the retropelvic vessels and the incision is continued through the kidney substance in the line of the lower calyx (Fig. 164). The incision gives ample room to explore the entire renal pelvis and is particularly suitable when the stone involves the pelvis and lower calyx. Only a slight thickness of renal tissue is involved and in a relatively nonvascular area. There is the disadvantage of dividing the retropelvic artery. The artery varies greatly in size and when small it may be divided without seriously interfering with the

The principal indications at present for nephrolithotomy are stones impacted or encysted in the calyces, stones in intrarenal pelves, and cases in which it is very difficult or impossible to expose the renal pelvis In most cases the stones can be removed through a very limited cortical incision and but little damage is done to the kidney (Figs 167, 168, 169, 170, 171 and 172)

Fig 168 —Pyelogram of the same case presented in Fig 167 Note dilatation of middle and inferior calyces distal to the stone The small shadow outside the pelvic area was not a calculus

Technique of Nephrolithotomy —The operative procedure varies according to the size and location of the stone and according to the circumstances under which the operation must be done When a stone is confined to a calyx, frequently the calyx is dilated and the overlying parenchyma is thin and fibrotic An incision made through the diseased area, which is easily recognized by palpation, causes no bleeding The stone is removed with forceps, a catheter is passed through the calyx into the renal pelvis for drainage, and the wound in the parenchyma is closed around the catheter with one or two interrupted sutures

be the operation of choice. It is probable that the erroneous idea that there is a relatively bloodless area just posterior to the convex border of the kidney has led many surgeons to incise the kidney widely, thinking that little injury would be done. Keyes has aptly stated that no one has found this line of bloodless parenchyma on the operating table. Large branching calculi, for which complete nephrotomy was at one time done, should in many cases be left alone When

Fig 167—Stone impacted in the lower calyx of the right kidney

they are suitable for operation, they can be removed by a combined pyelonephrolithotomy with less destruction of renal tissue and less danger of secondary bleeding. Aside from the greater mortality that attends extensive incisions into the kidney, secondary hemorrhage is a frequent complication and, when the kidney is infected, progressive pyelonephritis and renal atrophy often necessitate nephrectomy.

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of No. 1 plain catgut. When small stones are situated in a calyx with essentially normal parenchyma, the stone can usually be identified by probing for it through the parenchyma with a fine straight needle When the needle is felt to grate upon the stone, the needle is held in place while an incision is made onto the stone by the side of the needle and the stone is grasped with forceps and removed. If the kidney is to be drained, a catheter may be inserted and the wound is closed as mentioned above. If no drainage is to be used, clots and any particles that

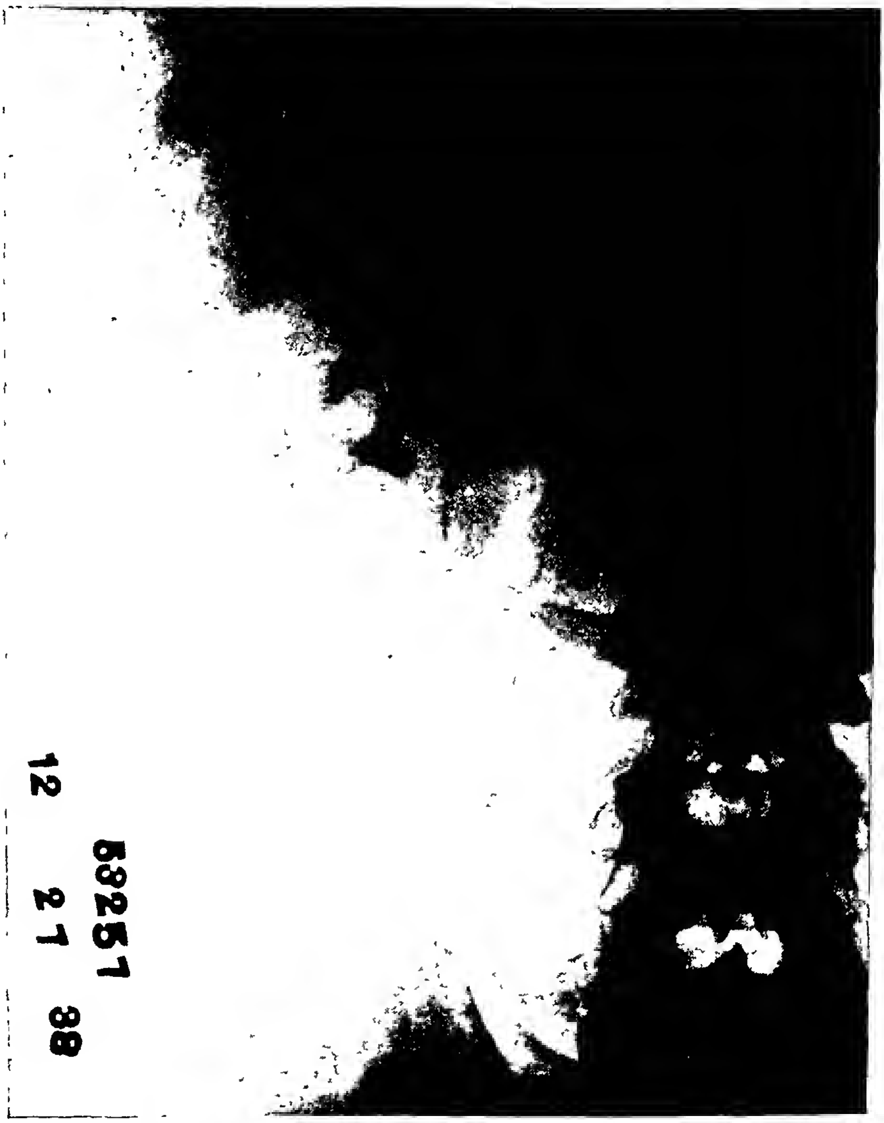

Fig. 169—Pyelogram of same case presented in Figs 167 and 168, thirty days following nephrotomy Note decrease in size of pelvis and calyces There is no evidence of injury to the kidney

have been dislodged from the stone are flushed from the calyx by a jet of warm saline solution directed into the wound and the wound is closed with interrupted sutures of No. 1 plain catgut.

Large stones occupying the renal pelvis and one or two calyces of the kidney are probably more satisfactorily removed through the cortex. Stones of such size can be palpated through the kidney. The incision follows the con-

tour of the stone until the calyces and pelvis are opened sufficiently to permit the stone to be removed intact A catheter is then placed into the pelvis through one angle of the wound and the cortical incision is closed accurately with interrupted sutures of No 1 plain catgut When at all practicable, I prefer to

Fig 170—X ray of large branching stone in the right kidney

Fig 171—Pyelogram of the same case presented in Fig 170 There is dilatation of the calyces above the stone in the right kidney Note undeveloped left kidney

bring the drainage tube through an uninvolved calyx This permits the wound in the kidney to be sutured more accurately The presence of a tube in the incision is a possible source of secondary hemorrhage

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bring the drainage tube through an uninvolved calyx. This permits the wound in the kidney to be sutured more accurately. The presence of a tube in the incision is a possible source of secondary hemorrhage

The most difficult nephrotomy is that in which a kidney pelvis of approximately normal size must be entered through the parenchyma. This necessity arises when a small stone is situated in an intrarenal pelvis or when, because of poor exposure, a short pedicle, or adhesions from a previous operation, the kidney cannot be sufficiently delivered to bring the pelvis into view. A small soft rubber tube should be placed around the vascular pedicle as a tourniquet so that the blood supply to the kidney can be temporarily occluded and an incision is made just posterior to the convex border of the kidney near the lower pole. The lower calyx is opened first. It is straight and wide and leads directly into the pelvis. Under normal conditions the anterior and posterior surfaces of the calyces are practically in contact, and the incision if not properly directed may pass the calyx and injure vessels at the hilum of the kidney. The calyx is from one to two centimeters from the surface and is recognized by the pearly white appearance of the mucous membrane. The incision should be made directly in

Fig. 172.—Pyelogram of same case presented in Figs. 170 and 171, one year following nephrotomy and removal of stones from right kidney. Note improvement in appearance of right kidney pelvis and calyces. Small stones remain near the lower pole of the right kidney.

line with a plane bisecting the kidney. When the incision is about 1.5 centimeters deep, the wound edges are retracted and the incision is cautiously extended until the calyx is entered. This is possible only when the blood supply is completely occluded. When it is difficult to enter the calyx, it is sometimes possible to invaginate the pelvis into the renal sinus and toward the calyx with the little finger and carefully locate the calyx in this way. In some cases it is possible to expose the pelvis or upper end of the ureter sufficiently to pass a small curved sound or a bent probe into the lower calyx and cut down onto the end of it. When the calyx has been opened, the incision may be extended toward the upper pole of the kidney until there is room to explore the pelvis and

remove the stone The wound in the kidney is then held together by pressure of the assistant's hands, one hand one one side of the kidney and one on the other, until the wound is closed with interrupted sutures The sutures should

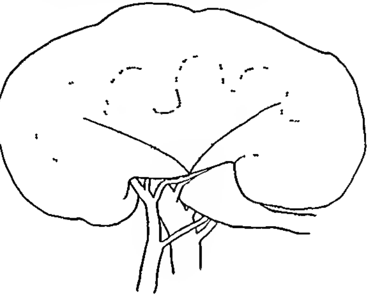

Fig 173 —An incision for nephrotomy described by George C Prather

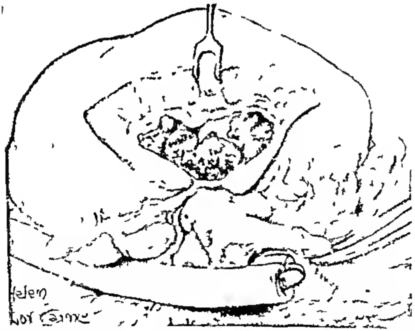

Fig 174 —Prather's operation for removal of large stones from the kidney A flap of renal tissue is retracted upward exposing the renal pelvis and calyces

be placed about a centimeter apart and should include the entire thickness of the parenchyma to approximate completely the surfaces They should not enter the calyx The sutures should be tied just tightly enough to approximate firmly

The most difficult nephrotomy is that in which a kidney pelvis of approximately normal size must be entered through the parenchyma This necessity arises when a small stone is situated in an intrarenal pelvis or when, because of poor exposure, a short pedicle, or adhesions from a previous operation, the kidney cannot be sufficiently delivered to bring the pelvis into view. A small soft rubber tube should be placed around the vascular pedicle as a tourniquet so that the blood supply to the kidney can be temporarily occluded and an incision is made just posterior to the convex border of the kidney near the lower pole. The lower calyx is opened first. It is straight and wide and leads directly into the pelvis. Under normal conditions the anterior and posterior surfaces of the calyces are practically in contact, and the incision if not properly directed may pass the calyx and injure vessels at the hilum of the kidney. The calyx is from one to two centimeters from the surface and is recognized by the pearly white appearance of the mucous membrane The incision should be made directly in

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When a kidney has two pelves, the upper and lower segments are usually quite distinct, having not only separate pelves but also separate blood vessels The divisions between the two portions are marked by a groove which varies greatly in depth, but is quite perceptible Resection should be done in this line of division The kidney should be liberated completely and the vascular pedicle exposed and examined carefully If blood vessels which pass to the diseased portion likewise supply the healthy segment, resection must be abandoned Nephrectomy should be done unless the condition of the opposite kidney requires that the healthy renal tissue be preserved When the healthy portion has an independent blood supply, the blood vessels and the ureter to the diseased part are doubly ligated and divided The capsule of the diseased portion, if not too adherent is separated and turned back to the line of demarkation and the kidney is divided The kidney should be divided when possible by an anterior and a posterior incision, each extending to the center of the kidney and so directed that a wedge of tissue will be removed This permits a more accurate closure of the healthy segment The wound in the kidney is closed with interrupted sutures of No 1 plain catgut placed about one centimeter apart The capsule which has been stripped from the diseased portion when rolled into a cuff along the margin of the wound, gives additional support to prevent the sutures from cutting in Finally, a tag of fat is sutured over the line of closure A nephropexy should be done to insure good position and drainage

There may be considerable inequality in size of the two segments of a kidney with two pelves The upper portion is often less than half the size of the lower portion When the disease is confined to the lower portion of the kidney there is little to be gained by leaving the upper segment and nephrectomy is usually advisable Occasionally, the volume of the two segments is nearly equal, or the opposite kidney is impaired, and resection of the lower segment is indicated It must be remembered that atrophy of the remaining portion sometimes follows resection, even when the operation has been carefully and skillfully accomplished Therefore, when the loss of functioning tissue would be disastrous, the advantages of nephrolithotomy and prolonged drainage should be considered

Stones blocking an upper or lower calyx often cause such localized destruction of the parenchyma that resection of the diseased area is preferable to nephrolithotomy Drainage of the kidney is rarely satisfactory following nephrolithotomy, especially if a lower calyx is involved Infection is difficult to control and often will spread to the healthy portion of the kidney Furthermore, resection is helpful in the prevention of recurrence of stone This operation is sometimes referred to as a calycectomy

After freeing the kidney and temporarily occluding the blood vessels, a wedge shaped section of tissue is excised Care should be taken to remove a narrow margin of healthy tissue The calyx that has been cut should be closed with a continuous suture of fine plain catgut (Figs 179 and 180) The wound in the parenchyma is then closed with interrupted sutures of No 1 plain catgut and covered with fat as described above (Fig 181) If the closure has been

(Text continued on page 258)

the surfaces. If too much tension is placed on the sutures, they will cut into the tissue. It is a popular procedure to place a thin layer of perirenal fat between the cut surfaces of the kidney, because of its hemostatic value. This is not necessary when the wound in the kidney has been sharply incised and the surfaces can be approximated accurately When lacerated surfaces must be approximated, tags of fat are very useful to help plug the defect and control bleeding.

George C. Prather stresses the importance of temporarily clamping the renal vascular pedicle whenever the cortex is incised for the removal of calculi. This prevents blood loss and permits a more accurate examination of the kidney He uses a semiflexible Doyen's curved intestinal nine-inch, rubber-covered clamp. The clamp is placed on the vascular pedicle just tightly enough to occlude the blood vessels and is released briefly every eight minutes to prevent damage to the parenchyma When removing large, branching stones, Prather makes a V incision on the posterior surface of the kidney with the apex at the pelvis and the ends of the incision extending toward each pole (Fig 173) The flap of cortex is lifted up with a small retractor and the stone is removed With the stone removed the openings of the calyces are within sight and may be explored if fragments have been left behind (Fig 174) The operation is completed by exploring the ureter with a bougie and suturing the nephrotomy incision Individual arteries of any size may be ligated They are easily found by momentarily releasing the clamp on the kidney pedicle The kidney is drained by a No. 18 Foley catheter which is so placed as to emerge from the end of the incision near the lower pole.

Prather's operation is obviously less destructive to renal tissue than a complete nephrotomy along the convex border, and when the pelvis is largely intrarenal it seems a very logical procedure The purpose of the operation is to remove the stone intact, but this is at times extremely difficult, especially when portions of the stone have grown in calyces with narrow infundibula. When this occurs, a short incision over the calyx to remove the retained fragment is the procedure of choice. Most of these kidneys are infected, and laceration of the parenchyma may be followed by infection and postoperative deterioration of the kidney.

Heminephrectomy

When calculi are associated with extensive destruction of the renal parenchyma confined to one pole, and when the rest of the kidney is healthy, resection of the diseased segment is often the treatment of choice This operation is performed in two types of cases: when the kidney has two pelves, one of which drains a diseased stone-bearing segment, and when a stone occludes an upper or a lower calyx. When stones are removed in such cases, the diseased portion of the kidney, usually infected and often poorly drained, is a menace to the healthy portion of the kidney and not infrequently requires a nephrectomy later. Resection of the kidney is particularly useful when diminished function or disease of the other kidney requires that all functioning tissue be preserved (Figs. 175, 176, 177 and 178).

Fig 177—Stone in lower calyx of the left kidney causing dilatation and poor drainage of the calyx

Fig 178—Same case as presented in Fig 177 six months following her [illegible]

Fig 175 —Pyelogram showing dilatation of the lower calyces of the right kidney because of renal calculi impacted at the calyceal orifice

Fig. 176 —Pyelogram of same case presented in Fig 175, two months following heminephrectomy

Fig 180—Heminephrectomy Interrupted sutures of No 1 plain catgut have been placed through the kidney cortex posterior to the line of incision The diseased portion of the kidney has been excised and the end of the exposed calyx closed with sutures of fine plain catgut. The reflected renal capsule is folded back to be used to cover the wound

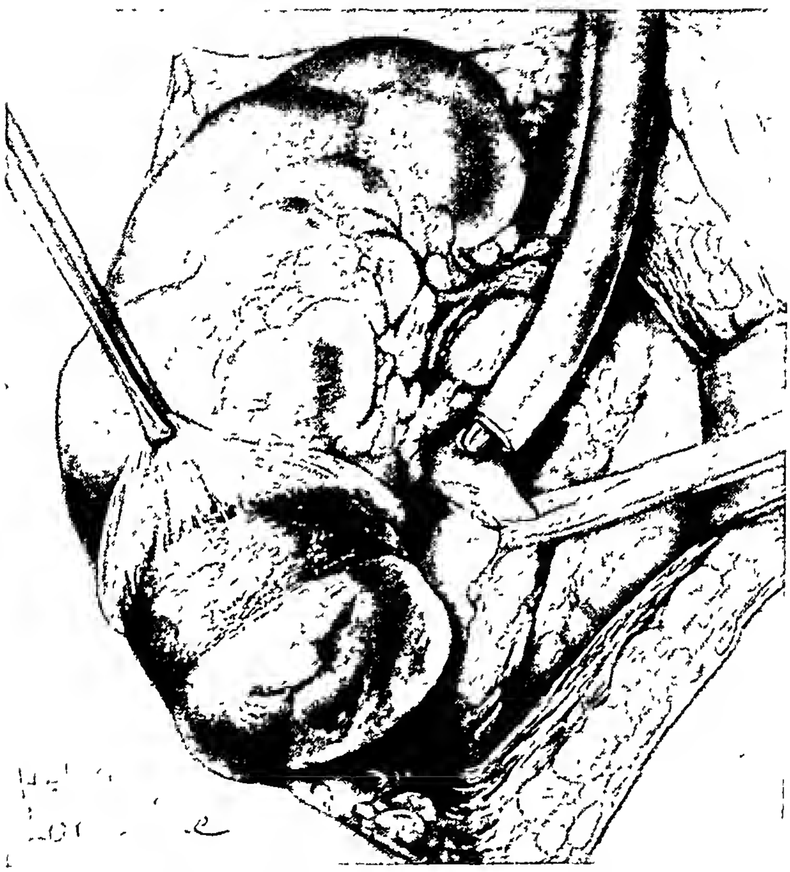

Fig 179 —Heminephrectomy for excision of diseased lower pole of the right kidney Capsule is divided and stripped upward

In secondary calculi the problem is much more difficult The urine is usually alkaline, in most cases because of urea splitting bacteria These organisms are frequently quite resistant to antibiotics or chemotherapy, and acidification of the urine is often difficult In my own experience adequate nephrostomy drainage, using two or three tubes when necessary, and copious irrigations of the infected renal cavity have been of greatest importance in eliminating infection, removing small calcareous fragments, and preventing the recurrence of stones

Fig 182.—Two nephrostomy catheters in place for continuous irrigation of renal pelvis Contrast substance in ureter indicates good drainage

I usually place the tips of two catheters in the renal pelvis and bring the catheters out through the lower calyx of the kidney (Fig 182) One catheter may be of small caliber to be used as the intake, while a larger catheter is used for the outlet When the pelvis is large, with dilated calyces, a third tube is at times placed through an upper calyx Irrigation is begun with normal saline solution about twenty four hours following the operation In a few days this is replaced by Solution G or 0 5 per cent acetic acid When the irrigating solution runs down the ureter and irritates the bladder, the strength of the solution may be reduced until tolerated Usually 500 c c of the solution is run through by a rapid drip twice a day The acid solution aids in eliminating infection and washes out blood clots and minute stone fragments,

done carefully, there will be no bleeding into the kidney pelvis and drainage of the pelvis is necessary only when there is a coexisting infection in the rest of the kidney. In that case, the drainage tube should emerge through an uninvolved calyx.

Postoperative Care

There is no operation in which postoperative treatment is more important than the removal of renal calculi. The three most important factors in the prevention of recurrence are complete removal of the calculi, adequate renal drainage, and the elimination of infection. Control of the reaction of the urine, also an important factor, is in many cases dependent upon the control of infection. Following the most careful and accurate operative procedure in which stones are completely removed and adequate drainage is assured, stones are apt to recur unless infection is controlled and the urine can be made acid or alkaline as conditions require

Fig. 181—Heminephrectomy operation complete Interrupted sutures tied over bits of fat to prevent cutting in

Adequate postoperative treatment is to a large extent dependent upon the composition of the stone and the type of bacteria that cause the infection. Postoperative treatment is rarely a difficult problem in primary renal calculi. The urine is usually acid, infection is minimal, and nephrostomy or pyelostomy drainage are indicated only when considerable trauma has resulted from the operation. In that case irrigations are not often necessary and the drainage tube should be removed as soon as the urine is clear. A free fluid intake is important, and urinary antiseptics or antibiotics should be given as indicated.

In secondary calculi the problem is much more difficult. The urine is usually alkaline, in most cases because of urea splitting bacteria. These organisms are frequently quite resistant to antibiotics or chemotherapy, and acidification of the urine is often difficult. In my own experience adequate nephrostomy drainage, using two or three tubes when necessary, and copious irrigations of the infected renal cavity have been of greatest importance in eliminating infection, removing small calcareous fragments, and preventing the recurrence of stones.

Fig 182.—Two nephrostomy catheters in place for continuous irrigation of renal pelvis. Contrast substance in ureter indicates good drainage.

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and occasionally causes soft calculi to disintegrate. When stones of appreciable size are left behind, 100 c.c. of 0.5 per cent urease solution is run through once a day, as suggested by Keyser.

The irrigations are usually continued two or three weeks, or as long as improvement is noted and circumstances will permit. In selected cases the patient is taught to use the irrigation and is permitted to return home with the catheters in place. In a few instances we have succeeded in ridding the kidney of fairly large stone fragments by this method. Urinary antiseptics or antibiotics are administered at the same time

After the drainage tubes are removed, the patient should be kept under close observation as long as there is a possibility of improvement or until there is reasonable assurance that the stone will not recur If infection or small stone fragments persist after the tubes have been removed, frequent cystoscopic pelvic lavage, using an acid solution, should be carried out when practical. In all cases a free fluid intake and a liberal, high-vitamin diet should be encouraged. When the stones are phosphatic, an acid ash diet is preferred, while an alkaline ash diet is desirable when the stones are of uric acid or cystine Acidifying drugs should be administered when necessary, care being taken to avoid acidosis in patients with impaired renal function.

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CHAPTER XII

HYDRONEPHROSIS; SURGICAL TREATMENT OF OBSTRUCTION AT THE URETEROPELVIC JUNCTURE

General Considerations; Division of Adhesions; Pyeloplasty; Ureteropyeloneostomy

HYDRONEPHROSIS

The successful treatment of hydronephrosis depends upon an accurate diagnosis of the cause or causes of the obstruction which interferes with adequate drainage. It is only by the complete relief of urinary stasis that satisfactory results can be obtained. Obstruction to the flow of urine may exist in any part of the urinary tract (Fig. 43). It may be caused by single or multiple lesions and may be mechanical or neurogenic in character. Secondary obstructive lesions may follow in the wake of a primary obstruction and remain to interfere with adequate drainage after the primary obstruction has been relieved. Examples of such secondary obstructive lesions are diverticula that accompany obstruction of the bladder, the long, tortuous, dilated ureter from lower ureteral obstruction (Fig. 53), or the fixed kink of the upper ureter that may result from nephroptosis. In some cases it is difficult to determine which obstructive process is primary and which is secondary. A stone in the pelvis of the kidney may produce a hydronephrosis by obstructing the pelvic orifice, or may be retained in the pelvis because of a previously existing obstruction which has caused the hydronephrosis (Fig 153).

Diagnosis.—There are no characteristic symptoms of hydronephrosis. The subjective symptoms are manifestations of the obstructive lesion, or the result of infection which so often follows. A patient under my care came because of fever and severe cystitis There was soreness in the loins, but at no time had there been pain characteristic of renal disease. There was advanced bilateral hydronephrosis. Neither can physical signs be depended upon. Frequently a very large hydronephrosis cannot be palpated, and when there is a palpable mass it must be differentiated from the many other disease processes causing enlargement of the kidney. Hydronephrosis is, therefore, recognized during the course of an examination to determine the cause of renal pain or tumor, or the source of pus or blood in the urine (Fig. 183). The complete diagnosis must determine as accurately as possible the cause of the condition and the relative importance of all primary and secondary factors. The probability of renal disease should be remembered when symptomatic evidence of gastro-intestinal disease cannot be confirmed by examination A detailed discussion of

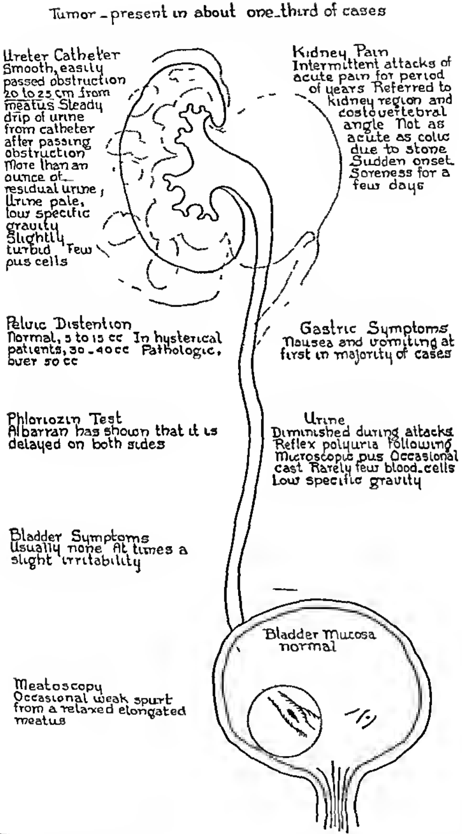

Fig 183 —Diagram showing signs symptoms and cystoscopic appearance of the bladder orifice in cases of hydronephrosis (Pilcher Paul M Practical Cystoscopy ed 2 1915 W B Saunders Co)

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HYDRONEPHROSIS

The successful treatment of hydronephrosis depends upon an accurate diagnosis of the cause or causes of the obstruction which interferes with adequate drainage. It is only by the complete relief of urinary stasis that satisfactory results can be obtained. Obstruction to the flow of urine may exist in any part of the urinary tract (Fig. 43). It may be caused by single or multiple lesions and may be mechanical or neurogenic in character. Secondary obstructive lesions may follow in the wake of a primary obstruction and remain to interfere with adequate drainage after the primary obstruction has been relieved Examples of such secondary obstructive lesions are diverticula that accompany obstruction of the bladder, the long, tortuous, dilated ureter from lower ureteral obstruction (Fig. 53), or the fixed kink of the upper ureter that may result from nephroptosis. In some cases it is difficult to determine which obstructive process is primary and which is secondary. A stone in the pelvis of the kidney may produce a hydronephrosis by obstructing the pelvic orifice, or may be retained in the pelvis because of a previously existing obstruction which has caused the hydronephrosis (Fig. 153).

Diagnosis.—There are no characteristic symptoms of hydronephrosis. The subjective symptoms are manifestations of the obstructive lesion, or the result of infection which so often follows A patient under my care came because of fever and severe cystitis There was soreness in the loins, but at no time had there been pain characteristic of renal disease. There was advanced bilateral hydronephrosis. Neither can physical signs be depended upon Frequently a very large hydronephrosis cannot be palpated, and when there is a palpable mass it must be differentiated from the many other disease processes causing enlargement of the kidney. Hydronephrosis is, therefore, recognized during the course of an examination to determine the cause of renal pain or tumor, or the source of pus or blood in the urine (Fig. 183). The complete diagnosis must determine as accurately as possible the cause of the condition and the relative importance of all primary and secondary factors. The probability of renal disease should be remembered when symptomatic evidence of gastro-intestinal disease cannot be confirmed by examination. A detailed discussion of

ing conditions (1) the functional value of the hydronephrotic kidney, (2) the condition of the opposite kidney (Fig 35), (3) the presence and severity of infection (Fig 51), and (4) the age of the patient The functional value of the kidney is much more important than the size of the hydronephrosis A large hydronephrosis with good function and free from infection may be treated successfully by plastic procedures, while a much smaller one accompanied by infection and renal atrophy will usually progress to complete destruction of the kidney, regardless of the treatment An infected hydronephrotic kidney with diminished function if operated upon at all, should be removed unless it is capable of carrying the total function if the opposite kidney is destroyed Hinman states that any unilateral hydronephrotic kidney which, after treatment by an indwelling catheter, is found incapable of excreting one fourth of the total function is close to the border line for nephrectomy It is to be expected that the function of a hydronephrotic kidney will improve after adequate drainage is established This will not be true to any great extent however, if compensatory hypertrophy has occurred in the opposite kidney In unilateral hydronephrosis the best results from conservative operations will be had in those cases free from infection and with very little evidence of renal damage When such early hydronephroses can be relieved by nephropexy, the liberation of adhesions about the renal pelvis and upper ureter, or the division of an aberrant artery, excellent results are almost always obtained When stenosis or high implantation of the ureter requires that the renal pelvis be opened, infection and postoperative adhesions may occur and diminish the probability of a cure Nephrectomy is usually indicated in large unilateral hydronephroses with diminished renal function and a healthy compensating mate Exceptions should be made in young patients if the function of the hydronephrotic kidney improves following catheter drainage, or if at operation there seems to be very little destruction of cortical tissue

When the opposite kidney is hydronephrotic or otherwise diseased, nephrectomy should not be done unless the kidney is entirely destroyed or so infected that there is little hope of recovery, and in any event so long as any function remains the kidney should not be removed until the opposite kidney has been restored as nearly to normal as possible The best results from plastic operations to improve drainage are obtained in cases of bilateral hydronephrosis This is explained probably by the fact that both kidneys are to some extent impaired and compensatory hypertrophy is not a factor Hinman has called attention to the importance of operating upon both kidneys in as short a time as possible so that compensatory hypertrophy will not have occurred in the first kidney operated upon, thereby limiting the chance of functional recovery of the kidney operated upon later When one of two hydronephrotic kidneys is greatly damaged, it is well to do a nephrostomy to conserve as much function as possible while the opposite hydronephrosis is being restored by a plastic operation The other kidney may then be removed or operated upon conservatively, depending upon its functional value and the results of the operation upon its mate

diagnostic methods and procedure is given in Chapter II. It is sufficient to call attention here to the importance of a thorough investigation of the entire urinary tract before deciding upon the treatment to be instituted. The source of obstruction may be located in any part of the urinary tract. The disease may be unilateral or bilateral; secondary processes may have been established, or the condition may be complicated by infection, stone or other disease The question of unilateral or bilateral pathology and the individual function of each kidney will decidedly influence the method of treatment. Small hydronephroses may be those of infantile or atrophic kidneys, while large sacs may be associated with considerable functioning renal tissue.

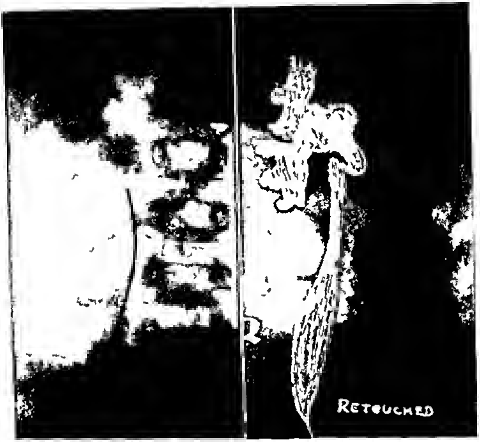
Surgical Treatment.—The surgical treatment of hydronephrosis consists of nephrectomy and operations designed to improve the drainage of the kidney. The operative procedures vary with the location of the obstruction, the functional value of the individual kidneys, the complicating factors, and with the necessity of conserving renal tissue. The age and physical condition of the patient are also important factors in determining the method of treatment Changes in the upper urinary tract resulting from infravesical obstruction vary greatly with the age of the patient and with the duration of the obstruction The stasis and dilatation of the upper urinary tract which result from prostatic enlargement or acquired urethral stricture are usually bilateral and are relieved when the obstruction is removed (Figs. 44, 45 and 46). Exceptions to this are occasionally seen when a vesical diverticulum or a hypertrophied interureteral bar produces additional obstruction. In cases of congenital infravesical obstruction the treatment is rarely so simple. There is often a fixed patency of the ureteral orifices, permitting regurgitation of the vesical contents up the ureter, and the ureters are usually dilated and tortuous, adding further to the impediment to free drainage from the kidneys. These cases require prolonged drainage and very careful investigation to determine the surgical procedure that will be most effective. Surgical methods in the treatment of this group of cases are discussed in Chapter XXXII

Surgical treatment is indicated in symptom-producing hydronephrosis when cystoscopic methods of treatment are ineffective, or are not applicable, and when the operative risk is not prohibitive Pyelographic studies occasionally reveal moderate dilatation of the renal pelvis unaccompanied by symptoms or evidence of impaired renal function There is little chance of improving the condition of such kidneys by operation They should be re-examined at intervals of twelve months until it is established that the condition is not progressive. No treatment is indicated if the urine remains uninfected and the dilatation of the renal pelvis does not increase. Both Lewis and McIver have called attention to the relief afforded cases of stricture of the ureteropelvic area by dilatation with ureteral bougies and catheters This treatment cannot be applied when there is angulation at the ureteropelvic area or ptosis of the kidney, and should not be continued when prompt relief is not obtained

The choice between conservative surgery and nephrectomy when hydronephrosis results from ureteropelvic obstruction depends chiefly upon the follow-

in addition, some type of plastic operation, (3) those requiring resection of the extrarenal pelvis including the ureteropelvic juncture with re implantation of the ureter, and (4) cases that require nephrectomy

Adhesions, either congenital or acquired, which involve the renal pelvis and upper ureter may cause obstructive kinks at or near the pelvic outlet, with retention of urine and dilatation of the kidney The adhesions may extend from the pelvis and ureter to the lower pole of the kidney, from the ureter to the pelvis, or may bind the ureter and renal pelvis to adjacent structures Not infrequently such obstruction is complicated by a low position or mobility of the kidney The liberation of such adhesions, completely freeing the upper ureter



A *B*

Fig 184 *A* and *B* —*A* Case 2 Hydronephrosis due to obstruction at ureteropelvic juncture on right side in a boy aged 5 years subjected to appendectomy 10 days previously under a mistaken diagnosis of appendicitis Preoperative pyelogram

B Case 2 Roentgenogram retouched to emphasize pathological condition (McIver R. B Journal of Urology December 1939)

and renal pelvis and carrying the dissection well up to the hilum of the kidney, with the addition of an accurate nephropexy, will correct the faulty drainage unless sufficient dilatation of the renal pelvis has occurred to cause the ureter to emerge from the pelvis at an area above the most dependent portion of the pelvis, or unless there are other obstructive lesions, such as stricture or an aberrant blood vessel There is some difference of opinion as to the importance of accessory renal vessels in the production of renal obstruction In the opinion

The presence of infection decidedly influences the operative treatment of hydronephrosis. If the infection is caused by colon bacilli and is limited to a few pus cells, and if there are no noticeable inflammatory changes in the kidney, plastic operations for the correction of hydronephrosis may be done with reasonable chances of success. When well-recognized pyelonephritis accompanies hydronephrosis, the probability of relief by conservative methods is greatly diminished. When the disease is unilateral with diminished function, and a normal kidney on the opposite side, nephrectomy should be done unless the infection can be eliminated. In cases where a single kidney or bilateral disease requires conservative treatment, the infection should be brought well under control before any effort is made to correct the obstruction. Continuous drainage and the administration of urinary antiseptics are often quite effective in eliminating infection, if the parenchyma of the kidney is not too greatly involved. In the milder cases drainage by ureteral catheter is adequate. When the infection is of long standing, with very cloudy urine and greatly impaired renal function, preliminary nephrostomy may be required. Drainage with irrigations of the kidney and the administration of urinary antiseptics should be continued until the urine is clear and function is at its maximum before any effort at plastic restoration is attempted. Antibiotics as indicated are very helpful in combatting such infections. When the infection persists and the conservation of renal tissue is necessary, permanent nephrostomy may be preferable to an attempt at plastic correction. The physical and civil status of the patient must often be considered when deciding upon the method of treatment to be employed. Before advising a plastic operation upon the kidney, it should be determined that the desirability of conserving renal function outweighs the chance of increased expense, danger, and loss of time that the operation entails. In active men, particularly wage-earners, a nephrectomy with a rapid convalescence is often preferable to the prolonged treatment and lack of assurance of cure that may be incident to conservative operations. Plastic operations in this class of patients are more properly reserved for those cases in which the destruction of renal tissue may shorten the life expectancy. Greater conservatism is properly practiced in children and in young adults, where recuperative power is at its height and where the conservation of renal tissue is of the greatest importance. In elderly patients operation is rarely necessary for hydronephrosis When an operation must be done because of pain or infection, nephrectomy should be done if the kidney can be spared; otherwise, a permanent nephrostomy is preferable in most cases.

SURGICAL TREATMENT OF OBSTRUCTION AT URETEROPELVIC JUNCTURE

A very satisfactory classification of obstructive lesions at the ureteropelvic juncture from the standpoint of surgical treatment has been published by McIver. He divides such cases into the following groups: (1) those that require division of bands and the disposition of polar vessels, (2) those that need,

devised an operation to relieve the ureter from obstruction by large accessory vessels without division of the ureter or vessel Areas of the anterior and posterior redundant walls of the pelvis are excised The pelvis is closed anteriorly in such a way that the portion to which the aberrant vessel is attached is drawn upward and inward The closure of the posterior wall draws the ureter upward and backward The Heineke Mikulicz principle of excision and closure is used A catheter is passed down the ureter and brought out through the parenchyma to splint the ureter, and a tube is placed in the pelvis for drainage It is evident that the disposition of aberrant vessels should depend upon the condition found at operation If it can be determined definitely that the obstruction is from other causes, there is no advantage in dividing accessory vessels Small vessels may be divided without causing noticeable destruction of renal tissue In the case of larger vessels temporary occlusion with the finger or a soft clamp will show the amount of renal tissue involved, by congestion or

Fig 186—Case 2 Serial pyelograms showing normal condition after operation for relief of obstruction (McIver R) Journal of Urology December 1939)

blanching of that portion supplied or drained by the vessel In noninfected kidneys the most to be expected from ligation of a vessel is fibrosis of the portion of the kidney involved If the kidney is infected, there is danger of an abscess or secondary hemorrhage A careful examination of the vascular pedicle will determine how extensive this will be If, by complete dissection of all adhesions as suggested by McIver or by resection of the renal pelvis according to Young's method, the vessels can be removed from contact with the ureteropelvic area, a satisfactory result should be obtained with the least interference with renal function In large vessels that cannot be disposed of except by ligation division and re implantation of the ureter is the best procedure

The second group includes those cases in which the extrarenal pelvis has become so dilated that the ureter emerges from an area above the most dependent portion (high or lateral implantation of the ureter), or in which there is stric

of some urologists they play only an accessory role in the production of hydronephrosis, serving as a band over which the ureter may be kinked in cases of nephroptosis, or as a secondary obstruction to an already enlarging renal pelvis This view probably arises from the frequent observation of accessory vessels running to the lower pole of kidneys in which there is no evidence of obstruction. Others with equally extensive experience are convinced that they are frequently the direct cause of renal obstruction. Jewett, in a study of 71 cases of hydronephrosis, reported that in 24 cases accessory renal vessels were the cause of obstruction In 1920 Quinby stressed the importance of these aberrant vessels as a cause of hydronephrosis and advised section of the ureter and re-implantation into the renal pelvis in an area that will remove the ureter from contact with the vessel in those cases in which the vessel supplies too much of the kidney to be divided safely. Patch has also reported a number of cases successfully treated

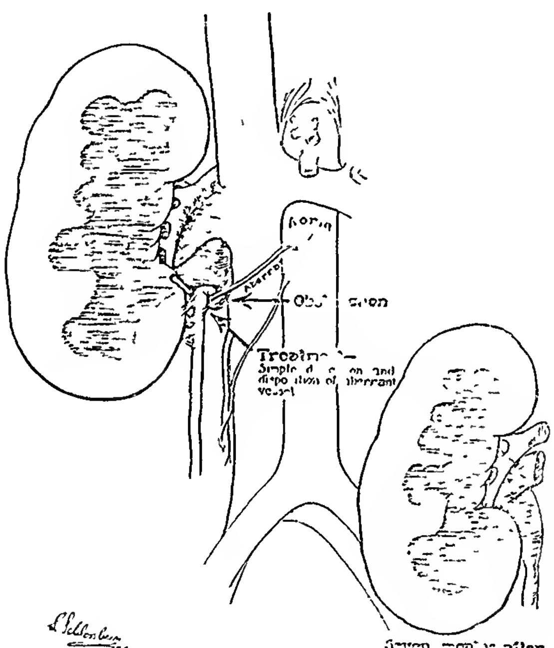


Fig 185 —Case 2 Drawings showing findings at operation and postoperative result (McIver, R B. Journal of Urology, December, 1939)

in this manner. Most operators prefer to divide the artery or vein, believing that little damage will result to the kidney and that the operation carries less risk than division and re-implantation of the ureter. McIver contends that in many cases thorough dissection and liberation of the upper ureter and renal pelvis will allow the disposition of large polar vessels without their division He states that as the adhesions between the obstructing vessels and pelvis are divided the movement of the pelvis is downward, while that of the vessels is upward, so that by simple dissection with division of bands and adhesions the obstruction may be completely relieved (Figs. 184, 185 and 186). Creevy reported a case in which an aberrant artery was released and displaced upward, apparently relieving the obstruction, but the operation was not successful. The artery continued to obstruct the pelvis at a higher level. H H. Young has

to overcome this objection to the Fenger operation, Schwyzer in 1932 reported his operation which in properly selected cases produces a very satisfactory pelvic outlet and is a definite improvement over the Fenger operation The constricted area at the ureteropelvic juncture is divided by an incision on the posterior sur

Fig 188 —Large hydronephrosis resulting from adhesions at ureteropelvic area Retrograde pyelogram

Fig 189 —Same patient following liberation of adhesions and resection of redundant portion of renal pelvis Intravenous pyelogram

face of the ureter The incision is continued on to the pelvis by two diverging incisions to form a V The apex of the V flap is pulled down to the lower end of the incision in the ureter and is sutured, thereby greatly increasing the pelvic outlet (Fig 191) This operation has been modified by Foley by making the

ture of the ureter at the ureteropelvic juncture, or a combination of these conditions. In the treatment of this group of cases many plastic procedures have been devised for the purpose of enlarging the pelvic outlet and providing adequate dependent drainage (Fig. 187). In 1891 Küster reported the first successful division and re-implantation of the ureter (pyeloneostomy) for the improvement of renal drainage. A review of the literature indicates that this remains the most successful plastic procedure in the treatment of hydronephrosis. Quinby in this country and Patch in Canada have reported a number of cases in which the ureter has been successfully divided and re-implanted for the correction of renal stasis resulting from accessory renal vessels. In 1898 Albarran reported two operative procedures for the treatment of hydronephrosis for cases in which the ureter was constricted and left the renal pelvis above the most dependent portion. He did a lateral anastomosis between the ureter and the most dependent portion of the renal pelvis, and divided and doubly ligated the ureter above the anastomosis In other cases, with no stricture of the ureter but with great

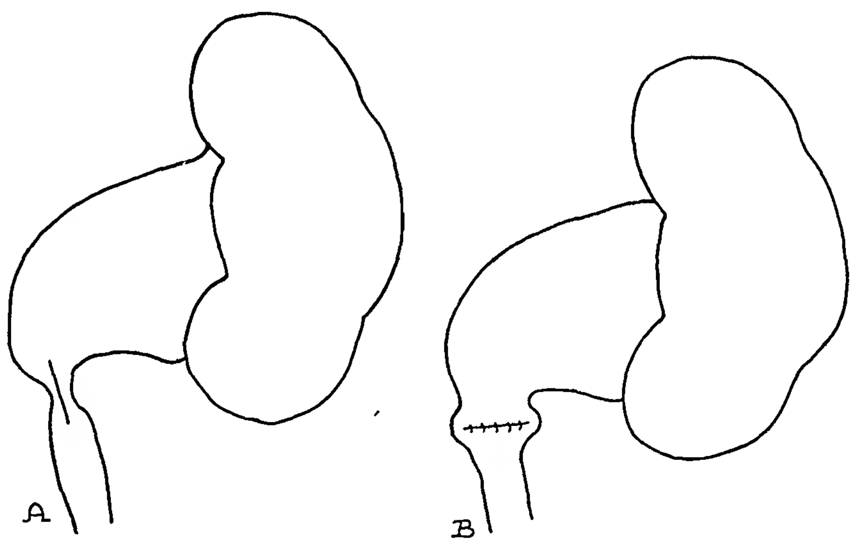


Fig. 187—*A*, Plastic operation for correction of short stricture of ureteropelvic area A longitudinal incision is made through the strictured area *B*, The longitudinal incision is sutured transversely, thereby enlarging the lumen

redundancy of the renal pelvis below the insertion of the ureter, he resected the lower pole of the kidney and the adjacent redundant pelvis, leaving the ureter to emerge from the most dependent portion of the newly constructed pelvis (orthopedic resection). Neither of these operations is frequently used in this country. Lateral anastomosis is not apt to be as successful as an implantation of the end of the ureter into the pelvis, and the second operation (orthopedic resection) requires the sacrifice of a portion of the renal tissue. Fenger adopted the Heineke-Mikulicz principle for the treatment of stricture of the ureter at the ureteropelvic juncture. This is the simplest operative procedure for increasing the diameter of the lumen of the pelvic orifice and the ureter (Fig. 190). Unfortunately, buckling of the opposite wall of the ureter frequently occurs, and many unsatisfactory results have been reported. In order

ing the upper portion of the ureter and freeing the pelvis up to the hilum of the kidney During the process of liberating adhesions, blood vessels should be spared wherever possible An adequate blood supply is important in the success of all plastic operations The complete liberation of the renal pelvis and ureter frequently relieves the obstruction, and nothing further is necessary except to suspend the kidney so that the pelvis and ureter are held in the proper alinement If, after completely liberating the renal pelvis and ureter, obstruction is not relieved, one of the several plastic procedures previously described should be done The most frequent causes of obstruction mentioned in the literature are stenosis or stricture and accessory renal vessels

Of the 71 cases studied by Jewett accessory vessels caused the obstruction in 24 patients, and in 43 there was stenosis at the ureteropelvic juncture, ten of which were complicated by an accessory vessel Of this group, adhesions were the primary cause of obstruction in only four patients In addition to adhesions, which frequently occur as an accessory if not as a primary cause, there may be excessive redundancy and fibrosis of the extrarenal portion of the pelvis or high insertion of the ureter which requires consideration The operation should be selected that will restore physiological function as nearly to normal as possible

When there is only moderate dilatation of the pelvis and the pelvic orifice remains in a dependent position, the obstruction may be relieved by much simpler procedures The pressure of renal vessels can be removed in some cases by the complete liberation of adhesions, permitting the ureteropelvic area to descend to a lower level In some cases the adhesive bands are more obstructive than the blood vessels If obstructing vessels are small, they should be divided When they represent a substantial portion of the renal blood supply, pelvic drainage must be re established by plastic operation In cases of uncomplicated stricture or stenosis at the ureteropelvic area or upper ureter, excellent results may be obtained by using the Ramstedt type of operation, first applied to the ureter by D M Davis in 1933 A small incision is made in the posterior wall of the renal pelvis and the largest catheter that will pass is inserted through the area of stricture Incisions through the stricture down to but not through the mucosa are then made It is better to make at least two, preferably four, such incisions The area of stricture is then dilated until a No 14 French bougie will pass easily A No 12 French catheter is passed from the pelvis down the ureter two or three inches below the stricture and the opposite end is brought through the renal parenchyma near the lower pole of the kidney One or two holes should be cut in the portion of the catheter which rests in the kidney pelvis so that the catheter will serve as a drain as well as a splint A nephrostomy tube, which has a ureteral splint extension tube such as that devised by Foley or by McIver, is satisfactory The splinting tube should remain in the ureter for two weeks, then retrograde dilatation of the ureter should be done at gradually increasing intervals until the danger of recontraction is passed

Ureteropyeloneostomy —Since the report by Kuster in 1891 of successfully dividing and reimplanting the ureter into the renal pelvis for the relief

ureteral incision on the lateral surface of the ureter facing the kidney and placing one line of the V on the anterior surface of the pelvis and the other on the posterior surface. When the incisions are closed, the pelvic outlet is not only enlarged, but is placed in a dependent position (Fig. 192). Von Lichtenberg in 1931 reported his operation in which he applied the principle of the Finney pyloroplasty to obstruction at the ureteropelvic area in which there was also high implantation of the ureter (Figs. 193 and 194). This operation, like the Foley operation, places the pelvic outlet in a dependent area. Each of these operations will give satisfactory results when properly applied and properly executed. The operative procedure should be selected that meets the condition encountered.

The third group consists of advanced cases of hydronephrosis in which the extrarenal portion of the pelvis is greatly dilated and the pelvic walls are thickened and inelastic. Even when the obstructive lesion is removed, a pelvis of this type may interfere with adequate drainage Conservative operations are rarely indicated in such cases unless there is definite need for the conservation of renal tissue, though in properly selected cases excellent results are obtained (Figs 188 and 189). Success depends upon the complete liberation of all adhesions, excision of the entire redundant portion of the pelvis, leaving only enough of the pelvic border to effect a closure without tension, accurate anastomosis of the divided ureter to the most dependent portion of the remaining pelvis, suspension of the kidney so that the ureter will remain straight, and prolonged nephrostomy drainage

The fourth group of cases consists of those in which the kidney is entirely destroyed, or in which there is unilateral hydronephrosis with greatly diminished function and compensatory hypertrophy of the opposite kidney. In borderline cases nephrectomy has the advantage of rapid convalescence and the surety of complete and immediate relief.

Plastic Operations for the Relief of Hydronephrosis.—For plastic operations in the treatment of hydronephrosis a large incision with adequate exposure of the kidney and upper portion of the ureter is essential. The lumbar incision (Fig. 82) is usually satisfactory It may be extended until sufficient exposure can be obtained. In short, thick patients resection of the twelfth rib (Fig. 93) gives a more satisfactory approach for this purpose. It is important to keep the perirenal fascia and fat as nearly intact as possible so that they may be used to support and protect the kidney when the operation is completed. The perirenal fascia should be divided near the hilum of the kidney posteriorly and reflected forward with the perirenal fat, as previously described on page 140. When this has been done, the wound should be widely retracted and the kidney and upper ureter carefully freed from adhesions, at the same time observing the anatomical relationship of the kidney, the renal pelvis and the ureter, and the relationship of these to the neighboring structures. In this way it is often possible to determine the primary cause of the obstruction; this in some cases is quite difficult. All bands of adhesions are divided, completely free-

should include only the fibrous and muscular coats of the ureter and renal pelvis and should be placed at sufficient intervals to approximate accurately the margins of the wound The ureter is splinted and the renal pelvis is drained as in other plastic procedures This operation is not so well adapted to strictures of such small caliber as the ureter Unless the area of stricture is very short, there is apt to be buckling of the opposite ureteral wall which defeats the purpose of the operation

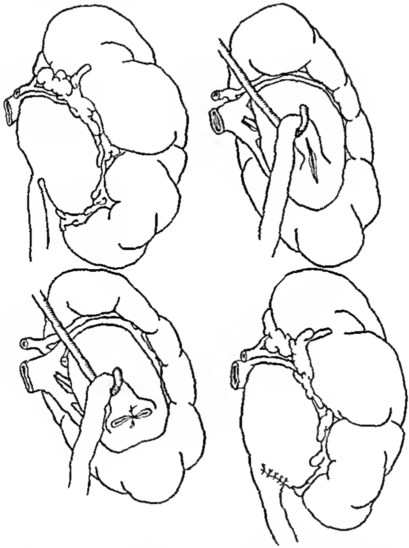


Fig 190—Technique of Fenger's pyloplasty (Heineke Mikulicz principle)

The Schwyzer Operation—Schwyzer's Y shaped incision was designed to overcome the buckling of the opposite ureteral wall that sometimes follows the Fenger *operation* A Y shaped incision is made on the posterior surface of the ureter and pelvis to form a flap which is sutured in the ureteral portion of the incision to enlarge the pelvic outlet The stem of the Y is made in the ureter and extends through the area of stricture similar to the Fenger *incision* From the upper end of this incision two incisions diverge onto the renal pelvis These

of hydronephrosis, this operation has been used probably more frequently than any other plastic procedure on the renal pelvis and ureter. Albarran in 1898 advised lateral anastomosis between the ureter and pelvis, but in this country the end-to-side operation is usually preferred and, judging from reports in the literature, better results are obtained than by any other plastic operation. Neoimplantation is usually used to eliminate stricture, to place the pelvic outlet at the most dependent portion of the pelvis, and to remove the ureter from the pressure effect of large accessory vessels as suggested by Quinby and by Patch.

The implantation has been done in a number of ways. The most satisfactory method is direct suture of the end of the ureter to an incision in the dependent portion of the pelvis. The ureter should be divided in a healthy area, immediately below the stricture if there is one, and the end should be cut slightly on a bias to aid in preventing constriction. An incision is made in the most dependent portion of the pelvis of the same length as the bias end of the ureter. A catheter, or the extension of an especially designed nephrostomy tube of proper size to fit loosely in the ureter, is passed through the opening in the pelvis down the ureter for several inches. The nephrostomy tube or catheter is drawn into the pelvis by the method of Cabot or by a similar procedure The end of the ureter is then approximated to the incision in the pelvis by atraumatic sutures of fine catgut, 000 to 0000 The sutures should not perforate the mucous membrane, should be few in number, and should be lightly tied to avoid tension A tag of fat is sutured over the area of implantation. If a straight catheter is used for splinting the portion which joins the pelvis, it should be perforated, and an additional nephrostomy tube is placed for adequate drainage of the kidney The operation is completed by doing a nephropexy to maintain the kidney and ureter in proper position Patch advises excision of a rosette of the renal pelvis with the ureter when rearranging the position of the ureter in relation to aberrant vessels The anastomosis is easier and probably more apt to be successful, but can be done only in those cases in which these is no stricture of the ureter.

Samuel Lubash splits the upper end of the ureter for a distance of about two centimeters and, after it is inserted into the new opening at the most dependent portion of the renal pelvis, the ureteral flaps are drawn out laterally through small stab wounds on either side of the neostomy opening and sutured to the pelvis with mattress sutures (Fig 201). The knots are tied outside the renal pelvis He believes that this method prevents tension at the point of anastomosis and maintains the true diameter of the ureter. Splinting the ureter and drainage of the renal pelvis are done as in other methods.

The Fenger Operation.—The Heineke-Mikulicz principle of transverse suture of a longitudinal incision was adopted for use at the ureteropelvic juncture by Fenger in 1892 A longitudinal incision is made through the area of stricture, beginning and terminating in healthy tissue With fine chromic catgut on a small needle the incision is closed transversely, first approximating the lower end of the incision to the upper end (Fig 190). Interrupted sutures

The apex of the flap is sutured directly into the lower end of the ureteral incision and the edges of the ureter are sutured to the edges of the defect in the renal pelvis (Fig 192) Foley recommends closely spaced sutures of 0000 chromic catgut The mucous membrane of the pelvis and ureter should not be included in the sutures Foley inserts a No 10 or 12 F soft rubber catheter through a stab wound in the posterior wall of the pelvis and into the ureter for a distance of 6 or 8 cm The portion of the catheter lying in the pelvis is perforated for drainage A second catheter extending only into the pelvis is inserted for additional drainage and through and through irrigation The splinting catheter is left in place for about 1 week The second catheter remains until adequate drainage through the reconstructed pelvic outlet is assured

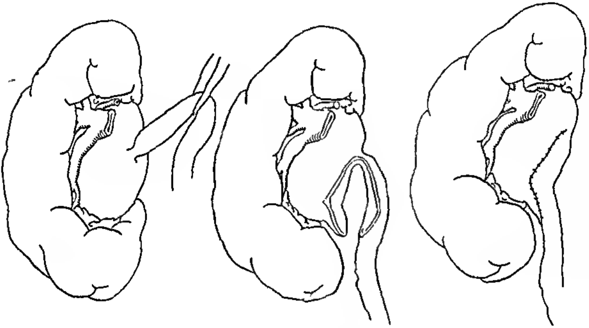


Fig 19 —Foley's pyeloureteroplasty

Of considerable value in the treatment of certain cases of hydronephrosis with ureteropelvic obstruction has been an operation reported by Culp and De Weerd in 1951 This procedure utilizes a flap of renal pelvis to aid in creating an adequate new ureteropelvic juncture

The kidney is exposed and mobilized in the usual manner and rotated medially and anteriorly to expose the posterior pelvis and ureteropelvic juncture An incision is then begun at the latter site, and the ureter is split throughout the full length of the constricted area into healthy ureteral tissue After the desired length of the flap has been determined, the incision is extended upward along the medial portion of the pelvis and by *following the* spheric contour it is terminated on the anterior surface A second incision is then made parallel to the first on the posterior surface *of the pelvis The two* incisions join at the upper end, but the base is widened to ensure an adequate new ureteropelvic juncture The pelvic flap is then *swung distally and* ca-

incisions form a V-shaped flap. The tip of the flap is pulled down and sutured into the lower end of the incision in the ureter. The rest of the incision is then closed as accurately as possible with interrupted sutures of fine chromic catgut Although there is some puckering of the wound, the operation is more apt to give satisfactory results in most cases than the transverse suturing of a straight incision. It produces some funneling of the pelvic outlet and the puckering of tissue is well above the ureteropelvic juncture (Fig. 191). Nephrostomy drainage and splinting the ureter and nephropexy complete the operation

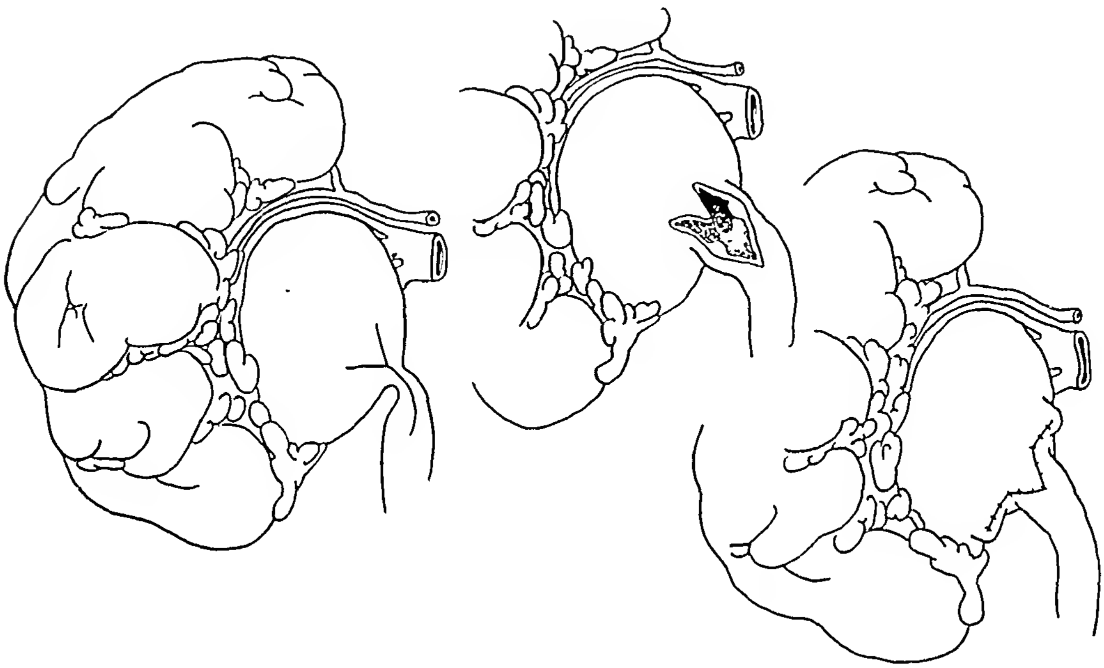


Fig 191 —Schwyzer-Durante's pyeloureteroplasty

The Foley Y-plasty.—The Foley operation is a modification of the Schwyzer technique and is designed to prevent distortion of the incision when sutured and to correct the high insertion of the ureter which is so frequently found in hydronephrosis After all adhesions have been liberated from the kidney and ureter, the kidney is rotated forward, the ureter and lower pole of the kidney are retracted upward and held in this position to facilitate accurate placing of the Y incision in the kidney pelvis and ureter. The stem of the Y is placed in the lateral wall of the ureter so that it will face the pelvis when the normal position is restored The incision is extended through the ureteropelvic juncture and into the median wall of the pelvis for an appropriate distance, depending upon the size of the pelvis and the position of the ureteropelvic juncture From this point two diverging incisions are made in the lower median wall of the pelvis in the form of an inverted V. The incision in the ureter should be equivalent in length to the incision in the pelvis plus that of the V-shaped flap. When the triangular-shaped flap of the pelvic wall is turned down, the incision in the pelvis, the triangular opening in the pelvis and the inner surface of the V-shaped flap of pelvic wall face the incision in the ureter

Resection of the Renal Pelvis—Resection of the renal pelvis is not necessary very frequently. The purpose of conservative surgery in cases of hydronephrosis is to improve drainage and relieve intrarenal pressure. Unless the pelvis is greatly enlarged with thickened, inelastic wall, there is no advantage in reducing its size by resection. Sargent has demonstrated the tremendous restoration that will result from adequate drainage alone. There are a few cases in which the plastic method of Young can be used to improve drainage by shifting the position of the ureteropelvic juncture. There are others in which prolonged obstruction has produced so much enlargement and fibrosis of the extrarenal portion of the pelvis that this redundancy of tissue may prevent complete drainage and the elimination of infection. When the pelvis is to be resected, the upper portion of the ureter and the pelvis are dissected free of all

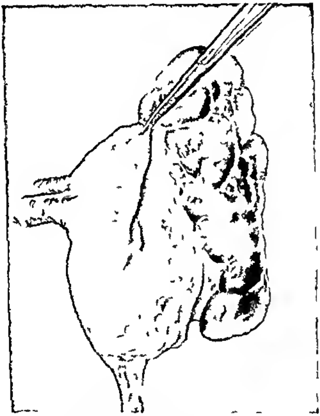


Fig 195—The redundant kidney pelvis is dissected free and adhesions are separated from the upper portion of the ureter

adhesions (Fig 195), and the vascular pedicle is isolated and protected. The cause of the obstruction is determined accurately by examining the ureter, the ureteropelvic juncture and the course of the blood vessels supplying the kidney. In these advanced cases often the fascia covering the pelvis can be stripped from the pelvis and reflected toward the kidney. The redundant portion of the pelvis is then excised beginning at the upper pole and leaving just enough pelvic border to close without tension (Fig 196). If there is no stricture or stenosis at the ureteropelvic juncture, the incision may be terminated just above the pelvic orifice and the lower portion of the pelvis closed as a tube continu

edge of the incised ureter sutured to the corresponding edge of the flap with interrupted sutures of 0000 chromic catgut. A small Foley catheter and a splinting tube of appropriate size are inserted through a lower pole nephrostomy site, and the tube advanced down the ureter for several centimeters. The remaining edges of the flap and ureter are approximated over the splinting tube with interrupted 0000 chromic catgut sutures, and the defect in the pelvis closed in similar fashion. The splinting tube is usually removed in three weeks, and the nephrostomy tube 24 to 48 hours later, provided there is good drainage as determined by nephrostomy injection.

A similar procedure, which has likewise been very satisfactory, was reported by Scardino and Prince in 1953

Fig 193

Fig 194

Fig. 193 —Von Lichtenberg's application of the Finney pyloroplasty to pyeloplasty Line of incision

Fig 194 —Von Lichtenberg's pyeloplasty, showing suture of the posterior wall

The von Lichtenberg Operation.—In cases of high implantation of the ureter von Lichtenberg's operation, based on the principle of the Finney pyloroplasty, may be used The free part of the ureter is drawn to the lowest part of the renal pelvis and fixed to it, side-to-side, with a few sutures. A horseshoe incision is then made, beginning on the pelvis at the lower end of the fixation line and continuing upward by the side of the ureter until the ureteropelvic opening is reached. The incision is then continued down the ureter to a point opposite the beginning of the incision in the pelvis (Fig. 193). The two inner edges of the wound are brought together with fine sutures (Fig. 194), and the closure is completed by suturing the two outer edges in the same manner. It is important to close the corners of the suture line accurately. The pelvis is drawn over the anterior suture line by a secondary line of sutures Von Lichtenberg stresses the importance of nephrostomy drainage.

Resection of the Renal Pelvis.—Resection of the renal pelvis is not necessary very frequently. The purpose of conservative surgery in cases of hydronephrosis is to improve drainage and relieve intrarenal pressure. Unless the pelvis is greatly enlarged with thickened, inelastic wall, there is no advantage in reducing its size by resection. Sargent has demonstrated the tremendous restoration that will result from adequate drainage alone. There are a few cases in which the plastic method of Young can be used to improve drainage by shifting the position of the ureteropelvic juncture. There are others in which prolonged obstruction has produced so much enlargement and fibrosis of the extrarenal portion of the pelvis that this redundancy of tissue may prevent complete drainage and the elimination of infection. When the pelvis is to be resected, the upper portion of the ureter and the pelvis are dissected free of all

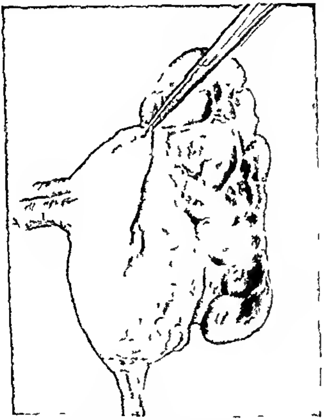


Fig. 195.—The redundant kidney pelvis is dissected free and adhesions are separated from the upper portion of the ureter.

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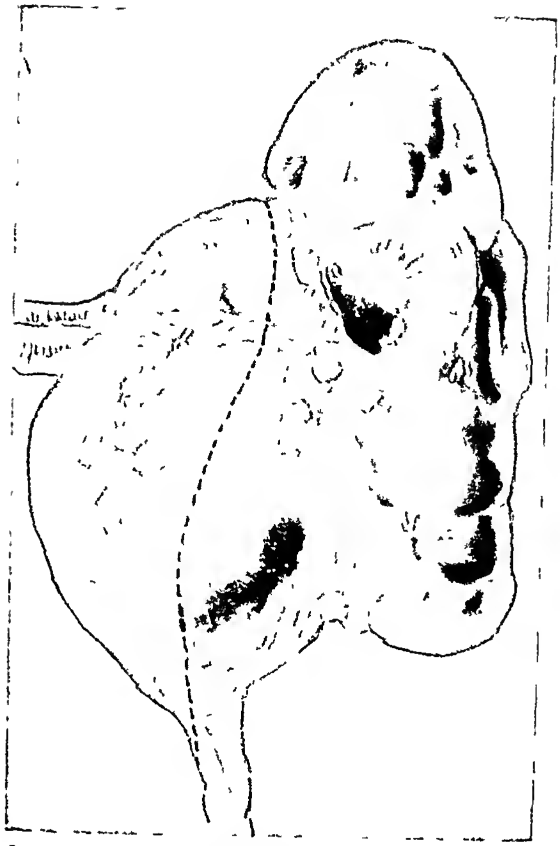

Fig 196 —Dotted line indicates the line of incision for removing the redundant portion of the kidney pelvis

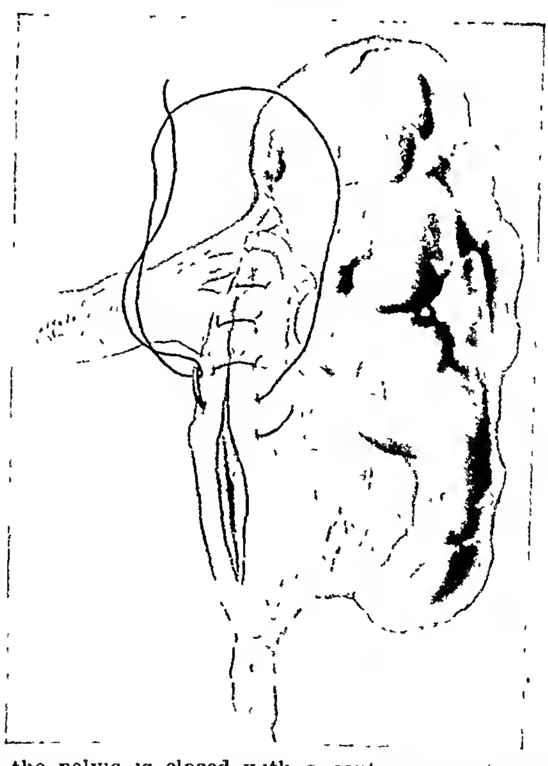

Fig. 197 —The wound in the pelvis is closed with a continuous suture of No 000 chromic or plain catgut The pelvic mucosa is not caught in the suture when possible to avoid it

ous with the ureter (Fig 197) In most cases it is necessary to resect the ureter When this is done, the ureter is reimplanted in the most dependent portion of the reconstructed pelvis by one of the methods previously described (Fig 198) The wound in the pelvis is closed by interrupted sutures of fine chromic catgut, 000 to 0000 Only sufficient sutures to approximate accurately the margins of the wound should be used The sutures should not perforate the mucous membrane and should be lightly tied (Fig 199) The fascia which has been reflected from the pelvis is then sutured over the wound with a continuous suture of very fine catgut The ureteropelvic juncture is splinted with a small catheter and nephrostomy drainage is provided (Fig 200) The operation is completed by a nephropexy

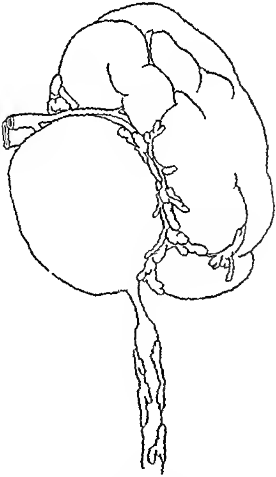

Fig 198—Outline of incisions for excision of large hydronephrotic sac and reimplantation of the ureter

The Ureteral Splint—Most urologists who have had experience with plastic operations on the kidney pelvis stress the importance of splinting the ureteropelvic juncture by a small catheter which is inserted down the ureter several inches and brought out through a stab wound in the renal pelvis or through the parenchyma of the kidney This splint keeps the upper portion of the ureter in proper alignment and should remain for a week or ten days

Fig. 199.—Ureter has been divided and the excess renal pelvis excised

Fig. 200—Renal pelvis closed with interrupted sutures of fine chromic catgut, fascia being closed over the pelvis in the same manner The ureter is being united to the newly formed pelvis with interrupted sutures of fine catgut McIver's nephrostomy tube in place, with the small portion of the tube distal to the bag extending down the ureter

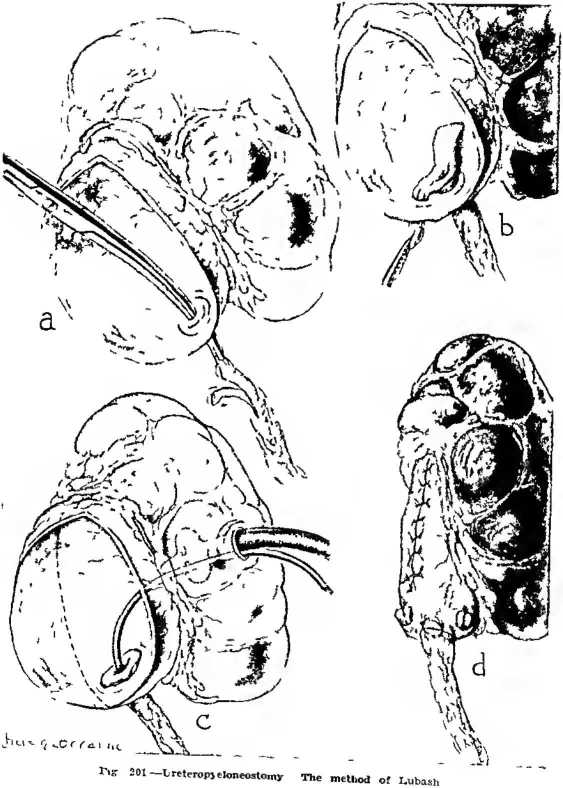

Fig 201.—Ureteropyeloneostomy The method of Lubash

Fig. 199—Ureter has been divided and the excess renal pelvis excised

Fig. 200—Renal pelvis closed with interrupted sutures of fine chromic catgut, fascia being closed over the pelvis in the same manner The ureter is being united to the newly formed pelvis with interrupted sutures of fine catgut McIver's nephrostomy tube in place, with the small portion of the tube distal to the bag extending down the ureter

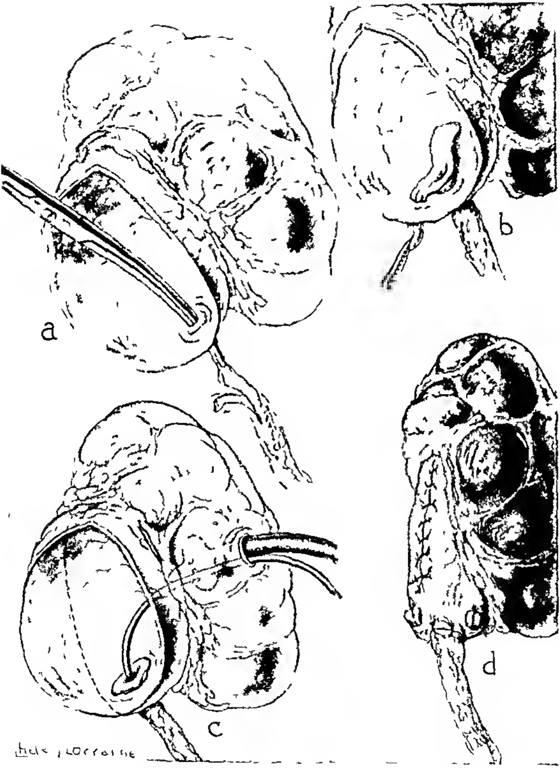

Fig 201 —Ureteropyeloneostomy The method of Lubash

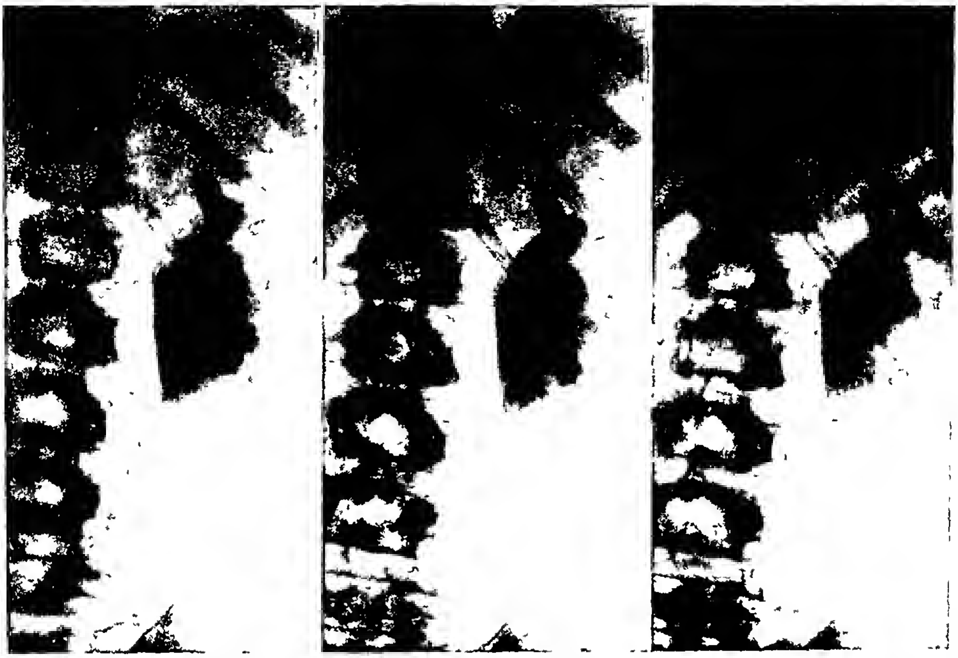

Fig 202.—Case 4 Exposures at 30, 45 and 60 minutes (McIver, R B Journal of Urology, December, 1939)

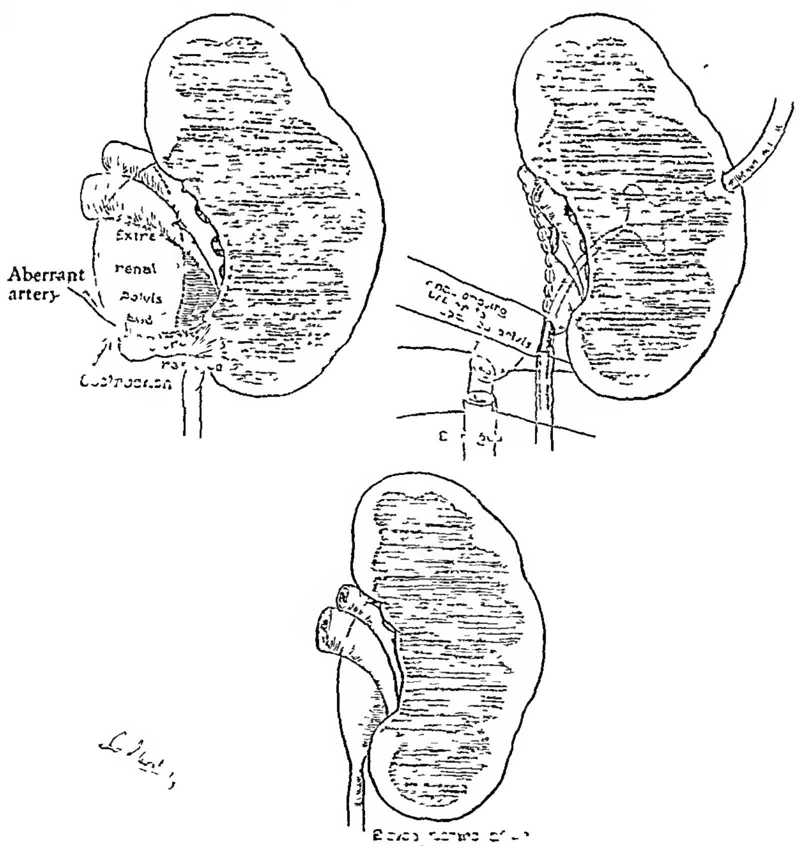

Fig 203 —Case 4 Drawings demonstrating operative steps, suture technique and postoperative result (McIver, R B Journal of Urology, December, 1939)

In the opinion of some writers a much longer time is desirable. A few authors object to the splint, in the belief that ischemia may be caused by pressure of the tube. This does not seem to be a logical objection if a catheter is used that fits loosely in the ureter.

Nephrostomy Drainage.—Drainage of the kidney following plastic operations is essential for satisfactory results. It assures continued renal function and prevents seepage of urine through the suture line with resulting infection and excessive adhesions. The drainage should be continued until healing is complete and satisfactory pelvic drainage is assured. This can be determined by the injection of colored solutions and temporary clamping of the tube. Usually the tube is left in for two or three weeks, depending upon the extent of the operation. When there is infection, it is often necessary to continue the drainage much longer.

Fig. 204.—Case 4. Serial pyelograms 11 months after operation showing small pelvis wide ureteropelvic juncture and rapid emptying time. (McIver, R. I.: Journal of Urology, December, 1939.)

The drainage tube may be inserted through the pelvis or the parenchyma of the kidney. Nephrostomy drainage is more satisfactory, as the tube is more apt to remain in place and can be replaced with little difficulty if it should become occluded or if prolonged drainage is necessary.

Nephropexy.—Fixation of the kidney in a position sufficiently high to keep the ureter straight is important. The kidney which has been completely mobilized, if not held in place, may assume a position that will permit kinking of the ureter and poor postoperative results. An elaborate nephropexy is not necessary. A few sutures for attaching the renal capsule to the lumbar muscles are usually sufficient. If the perirenal fascia has been preserved intact, the nephropexy advocated by Deming (pages 216-221) is quite satisfactory.

Prognosis.—In properly selected cases satisfactory results may be expected when the principles of plastic surgery are strictly adhered to (Figs. 202, 203, and 204). The indications for plastic operations on the kidney pelvis are dis-

Fig 205 —Anterior wall of the left hydronephrotic kidney in child twelve years of age, apparently resulting from congenital ureteropelvic stenosis (Dodson Virginia Medical Monthly, December, 1928)

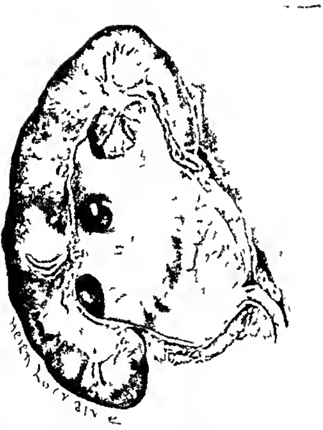

Fig 206 —Hydronephrotic kidney resulting from fixed kink at the ureteropelvic juncture

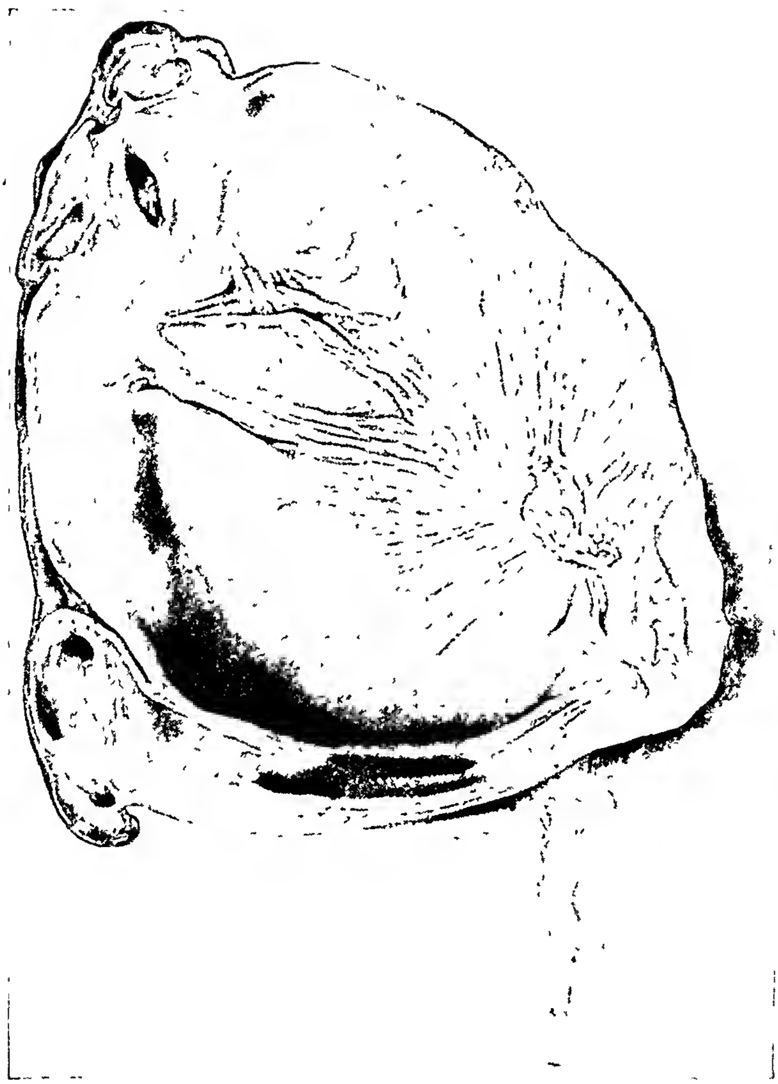

Fig 205—Anterior wall of the left hydronephrotic kidney in child twelve years of age, apparently resulting from congenital ureteropelvic stenosis (Dodson Virginia Medical Monthly, December, 1928)

done, and the kidney and upper ureter are immobilized by splinting the uretero pelvic juncture and by nephropexy, with adequate nephrostomy drainage, ultimate improvement in the existing condition may be expected It must be remembered, however, that kidney tissue destroyed cannot be restored, and a large distorted renal pelvis will rarely assume a normal size and contour (Figs 205, 206 and 207) A satisfactory plastic procedure should accomplish the following results (1) relief of pain, (2) satisfactory emptying, (3) improvement in function, and (4) anatomic involution The reports in the literature indicate that excellent results can be obtained in properly selected cases

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cussed in the early part of this chapter. It is well to repeat that the positive indications for operation are pain unrelieved by simpler methods and the need for conservation of renal tissue. Pain is just as promptly and often more surely relieved by nephrectomy, but if the kidney contains sufficient functioning tissue to sustain life, or if the opposite kidney has limited functional value, an effort to preserve the kidney by plastic operation is justified. It is most important to remember that uncontrolled infection is the greatest obstacle to a satisfactory

Fig 207 —Hydonephrosis resulting from kink at the ureteropelvic area, kink apparently caused by adhesions Note anomalous distribution of blood vessels

result. The prognosis is always poor in chronically infected kidneys. When operations are undertaken upon such kidneys, nephrostomy drainage should be continued for several weeks and in some cases must be permanent.

The most important principles of plastic surgery are preservation of the blood supply, the absolute control of bleeding, accurate closure of wounds without tension, and immobilization. If the operation is carefully and accurately

Fig 208A.—Solitary cysts of the kidney Large cyst at the lower pole and smaller cyst at the upper pole destroyed most of the renal tissue by pressure (Dodson Southern Medical Journal March 1933)

Fig 208B.—Large solitary cyst growing from the convex surface of the right kidney

CHAPTER XIII

CYSTS OF THE KIDNEY AND THEIR TREATMENT

Only a few of the different types of cysts are of surgical interest. The multiple small cysts found in chronic nephritis chiefly concern the pathologist. Cysts occur occasionally as a result of liquefied occlusion of tuberculous processes and occasionally malignant tumors of the kidney undergo liquefication. Dermoid cysts are found very rarely and probably should be classified as embryomas Hydatid or echinococcus cysts occur in only about 5 per cent of echinococcus infections Since this disease is uncommon in this country such cysts will not often be encountered. Eosinophilia and the presence of daughter cysts and hooklets in the urine help to differentiate these cysts from other cysts and tumors of the kidney.

Perirenal cysts usually result from renal trauma. Extravasated blood becomes encapsulated. Such cysts are diagnosed by a history of trauma and by the roentgenogram which shows an outline of a calcified cyst wall. It is difficult to differentiate these cysts from solitary cysts of the kidney with calcifications in the cyst wall.

The types of cystic disease of the kidney of greatest clinical interest are solitary cysts and polycystic disease Solitary cysts usually require surgical treatment; and polycystic kidneys require surgical treatment only when some complication has arisen or when drainage of some of the cysts is necessary for the relief of pain or to improve renal function.

SOLITARY CYSTS

The etiology of solitary cysts is a subject of considerable controversy. Whether they are of congenital origin or result from vascular damage plus tubal blockage as suggested by Heppler is of very little clinical importance. They may grow from either pole (Fig. 208*A*) or from the convex border of the kidney (Fig. 208*B*). The predominant position is in the lower pole. The point of origin may be superficial, in which case there is very little destruction of renal tissue, or well below the surface, being partly surrounded by renal tissue and causing considerable damage by pressure. They are densely adherent to the kidney. The renal tissue adjacent to the cyst wall is compressed and shows chronic irritation. The cyst wall is composed of fibrous tissue and is partly or completely lined by low cuboidal epithelium.

Diagnosis.—It is rarely possible to make a positive diagnosis of solitary renal cyst before operation. The patient usually complains of dull continuous pain in the loin or a mass in the upper portion of the abdomen. Hematuria is occasionally noted. The cyst is usually quite tense and not easily differentiated from solid tumors by palpation. When situated at the upper pole, the kidney may be pushed downward, simulating a low movable kidney. It can usually be palpated from front to back, and has not the wide range of mobility found in ovarian cysts and omental cysts. It is situated somewhat more laterally than a

Fig 208A —Solitary cysts of the kidney Large cyst at the lower pole and smaller cyst at the upper pole destroyed most of the renal tissue by pressure (Dodson Southern Medical Journal March 1933)

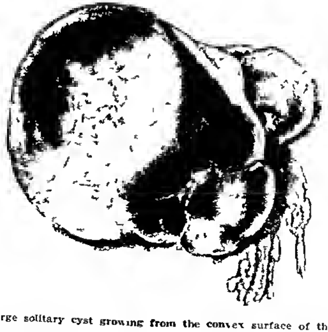

Fig 208B —Large solitary cyst growing from the convex surface of the right kidney

cyst of the pancreas. The radiographic shadow of the cyst is somewhat less dense than that of the kidney or of a solid tumor. The pyelogram may be negative or one of the calyces may show evidence of pressure (Fig. 209). The calyx is shortened and the terminal portion is compressed There is never the obliteration of calyces that is seen in tumors of the renal parenchyma. There is frequently some impairment of the function of the affected kidney

Treatment.—Operation should be done unless it is contraindicated by associated disease or senility. Excision of the cyst is the treatment of choice unless there is evidence of malignancy, such as an extremely thickened cyst wall or blood in the cyst cavity If there is doubt the cyst may be excised and examined immediately, nephrectomy to follow if there is malignancy. When there is considerable destruction of renal tissue nephrectomy should be done.

Fig 209 —Pyelogram of cystic kidney illustrated in Fig 208*B*

If the cyst arises from one of the poles of the kidney, the excision may be done according to the method of partial resection of the kidney described on pages 252-258. If a large area of the kidney is involved, simple excision of the free portion of the cyst wall and treatment of the adherent portion of the cyst cavity by phenolization or the use of Zenker's solution are satisfactory.

POLYCYSTIC DISEASE

Polycystic disease of the kidney is a congenital condition and is considered to be practically always bilateral (Fig. 37). The disease may run its course in infancy or early childhood or may exist until late in life The largest percentage

of cases is seen in the fourth decade. Many observers have noted a marked hereditary tendency. The disease often occurs in two or more members of the same family and in succeeding generations. According to Young it is recognized in three clinical types: (1) The uremic form, running a very short course, from a few days to a few weeks, with the patient previously in reasonably good health, but failing rapidly with headache, drowsiness, abdominal distention, and hiccough. (2) The chronic nephritic form which runs a much longer course, usually ten or even twenty years after diagnosis, showing the clinical characteristics of a true chronic nephritis with circulatory changes, low specific gravity of the urine and albuminuria. (3) Finally, those cases that come to operation as the result of infection, obstruction, severe pain or hematuria. This last may be called the surgical form and usually has a duration from onset of symptoms of from three to four years. The symptoms, such as hematuria, lumbar pains, kidney colic, and pyuria, may simulate any of the major surgical lesions of the kidney.

Diagnosis.—The diagnosis of polycystic disease is not so difficult as in other cystic diseases of the kidney. The growth is large enough to be definitely palpated before there are sufficient symptoms to require medical attention. The patient most frequently seeks medical aid because of hematuria, pain in the region of the kidneys or in the abdomen, digestive disturbances or abdominal tumor. Frequently careful examination will elicit palpable tumors on both sides of the abdomen, and the fact that the growths are bilateral will differentiate them from most enlargements of the kidneys. The tumor is tense and irregular in outline because of the numerous cysts. The pyelogram is characteristic. The kidney pelvis is compressed and the calyces are separated and elongated so that the distance from the upper to the lower calyx may be twice the normal. There is rarely a filling defect or obliteration of a calyx as is seen in tumor of the kidney. Pyelogram on the opposite side will show a similar picture. The specific gravity of the urine is constantly low and there is a diminution in the total renal function as indicated by the phenolsulphonephthalein test. The attacks of bleeding which are frequently symptoms of both tumor and cyst are much more often accompanied by pain in cystic disease than in tumor.

Treatment.—Surgical treatment is frequently indicated in polycystic disease of the kidney. Cahill and Fish reported a series of fifty-eight cases in which operative procedures were carried out in twenty-three. They divided those patients requiring operation into the following six groups: (1) where physical trauma to the kidney or spontaneous rupture of cysts caused severe hemorrhage within or around the kidney; (2) renal or perirenal infection; (3) obstruction to the flow of urine caused by pressure of cysts within the kidney or upon the ureter; (4) obstruction or pain due to calculi; (5) tumor or tuberculosis of the kidney; and (6) increasing hypertension without other evidence of renal failure. To this group, I would add those cases in which there is persistent pain resulting from growth of the cysts.

For many years some surgeons have advised puncturing the cysts of polycystic kidneys for the relief of pain and to delay the progressive destruction of the kidneys. The success of this operation is variable. In my experience,

Fig 210 —Advanced polycystic disease Symptoms, hypertension and left lumbar pain.

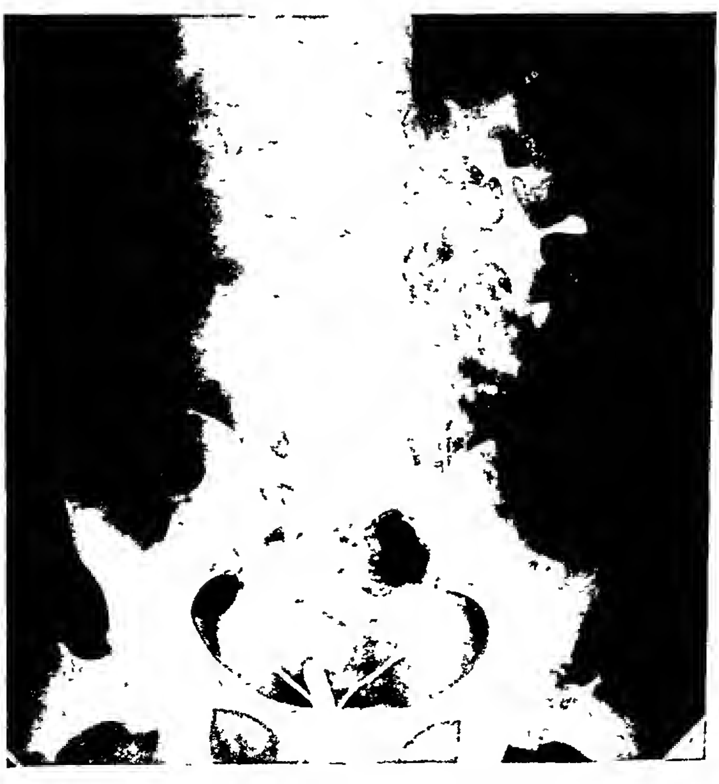

Fig 211 —Same patient as in Fig. 210, following operations for excision and aspiration of cysts. Symptomatic relief.

the results are encouraging if there remains a reasonable amount of functioning tissue as indicated by the dye tests. Pain will be relieved and function improved by draining all accessible cysts (Figs 210 and 211) The outer wall of surface cysts should be excised and cysts deep in the kidney aspirated with a large needle (Fig 212) If the disease has progressed to the point of impending renal failure as evidenced by nitrogen retention and the elimination of only traces of dye, the prognosis of surgical treatment is not so good. This, of course, does not hold true when cysts near the lower pole of the kidney are obstructing the ureter by pressure

Fig 212—The outer wall of superficial cysts is excised and the contents of centrally located cysts are aspirated

A E Goldstein has devised an operation for aspiration and prolonged drainage of cysts when there is progressive enlargement of the cysts with progressive reduction of renal function, pain, or hematuria. The kidney is exposed by an abdominal or lumbar incision. The capsule is stripped off, rupturing many of the superficial cysts. The kidney cortex is then split from one pole to the other. The incision is not carried deep enough to enter the calyces or renal pelvis. Many more cysts are then exposed and are opened or aspirated. The split halves of the kidney are then approximated to the skin edges, leaving the split surface of the kidney exposed. Wet gauze is applied to the wound which

is kept open as long as possible When the wound has healed by granulation, the surface of the kidney is just beneath the scar. Subsequent aspiration of cysts with a needle and syringe may be done when indicated.

Nephrostomy is occasionally indicated in polycystic kidneys because of obstruction at the ureter or at the pelvic area or because of stone in the pelvis or calyces. It is usually very difficult to expose the pelvis, for the large size of the kidney covers it. The operation of nephrostomy is facilitated by puncturing or aspirating all of the accessible cysts. Following this the operation is carried out by the procedures described on pages 178-185. The nephrostomy tube should be kept in place until the urine is clear and free drainage through the ureter is assured. When polycystic disease is complicated by calculi in the renal pelvis, pyelolithotomy should be done if the pelvis can be exposed.

Nephrectomy is indicated only when infection in a completely destroyed kidney is endangering the life of the patient or when intercurrent disease such as tuberculosis or tumor is present In many cases, infection of the polycystic kidney can be controlled by adequate drainage and the generous use of penicillin, streptomycin, and the sulfonamides I had occasion to treat a patient with bilateral infection. On one side there was a perirenal abscess and many of the larger cysts were filled with purulent material On the opposite side, the infection was confined to the cysts. Drainage was instituted by placing several small tubes around the kidney and in the larger cyst cavities The wounds were only partly closed. Sulfathiazole and penicillin were administered Recovery was complete with eventually almost normal function. When adequate drainage is not possible, nephrectomy may be necessary as a lifesaving measure

Polycystic disease is often more advanced in one kidney than the other and when nephrectomy is required the opposite kidney is usually capable of sufficient function to sustain life for several years I encountered two patients in the same family who survived nephrectomy, one eight years and the other twenty years.

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CHAPTER XIV

TUMORS OF THE KIDNEY AND THEIR TREATMENT

Tumors of the Adult Renal Parenchyma, Tumors of the Renal Pelvis, Tumors of the Renal Parenchyma in Children

From the clinical point of view tumors of the kidney may be divided into three groups (1) tumors of the adult renal parenchyma, (2) tumors of the renal pelvis, and (3) tumors of the kidney in childhood

The surgical pathology of these tumors forms a very interesting problem for study The chief aim of the surgeon, however, must be directed toward their early diagnosis and treatment, since with few exceptions they are all malignant and run essentially the same clinical course (Fig 213) It is a good rule, therefore, to consider all renal tumors as malignant until they are definitely proved otherwise The failure by both the patient and the physician to recognize these tumors early contributes largely to the poor results that are usually obtained in treatment

TUMORS OF THE ADULT RENAL PARENCHYMA

Adenocarcinomas are the most common renal tumors, composing about eighty per cent of the cases reported These tumors may be classified as (1) papillary adenocarcinoma (a) with clear cells, (b) with granular cells, (2) malignant cystadenoma, and (3) alveolar carcinoma While the clinical manifestation of each of these tumors is the same, there is decided difference in the histologic structure These tumors also differ to some extent in the degree of malignancy, therefore a pathological diagnosis is of value in determining the prognosis

The following is not presented as a complete description of these tumors pathologically but merely as an aid to their identification

Papillary adenocarcinomas with clear cells constitute the largest group of renal tumors These tumors are well circumscribed and show little tendency to infiltrate the renal tissue (Figs 214 and 215) They grow slowly and often are very large before causing symptoms other than a mass in the loin On cross section they have a yellowish appearance, frequently with hemorrhage and necrotic areas (Fig 216) Histologically they are composed of papillary strands of connective tissue and fine capillaries covered with large clear cuboid or columnar cells often resembling carcinomas arising from the adrenal cortex Grawitz, who first described them in detail, believed that they were derived from the adrenal gland At the present time they are often spoken of as hypernephromas or Grawitz tumors but most pathologists consider them to be adenocarcinomas peculiar to the kidney They metastasize through the blood stream, most frequently to the lungs, bones and liver Often a metastatic lesion is recognized before the primary tumor is known to exist (Figs 217 and 218)

Granular cell papillary adenocarcinomas do not produce large nodular growths. They are grayish white and more homogeneous in texture than the clear cell tumors. They are less distinctly encapsulated and show a greater tendency to infiltration and to invasion of the renal pelvis. They are composed of smaller granular staining cells which vary in arrangement from a papillary to an alveolar form. They are more malignant than the clear cell tumors and frequently metastasize through the lymphatics

Malignant cystadenomas are well-encapsulated whitish tumors. They grow slowly and metastasize late The prognosis is better than in any other renal cancer. Histologically there is a fine connective tissue stroma lined with small, deeply staining cuboidal cells arranged in distinct papillary formation.

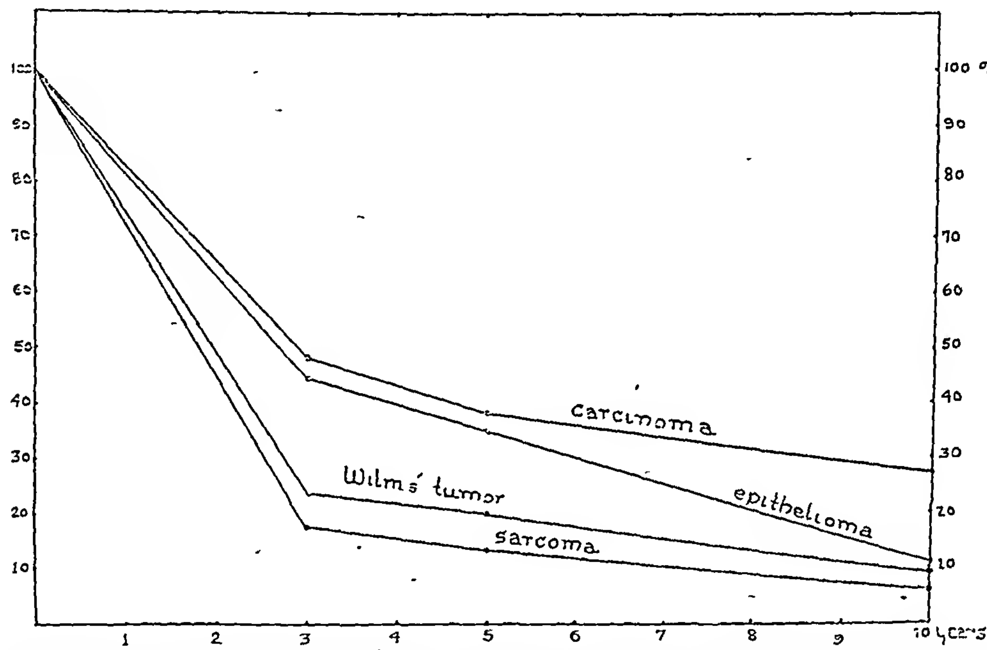

Fig 213—Chart illustrating survival following nephrectomy, according to the type of renal neoplasm (Priestley, James T. Journal of the American Medical Association, 113 902-906, September, 1939)

Alveolar carcinomas are the most malignant of this group. They are whitish homogeneous growths without a distinct capsule. They show a marked tendency to infiltrate the renal tissues and invade both the blood stream and lymphatics Microscopically the cells are ovoid or rounded and vary in arrangement from a form resembling normal renal tubules to one in which there is an entire lack of cell differentiation and in which the cells are packed closely together as in sarcoma.

Mesodermal Tumors.—Tumors of mesodermal origin are rather rare. They may occur at any age although the majority are reported in the adult. The most frequently recognized tumor of this group is sarcoma (Figs. 219 and 220), which varies considerably in histologic structure, is always highly malignant, and usually terminates fatally. *Spindle cell sarcoma is the most common type.* The rarer forms are fibrosarcoma, leiomyosarcoma, liposarcoma, and lymphosarcoma.

Benign tumors of the kidney are usually quite small and most cases are reported at autopsy or are noted when operating upon the kidney for some other lesion. Occasionally a rather large fibroma or leiomyoma is encountered. The benign character of the tumor is recognized by pathological examination. M. P. Gordon removed a leiomyoma weighing 830 grams from a Negro girl 15 years of age. In reporting this case, Gordon, Kimmelstiel, and Cabell could find only 17 cases reported in which the tumor had reached sufficient size to cause clinical symptoms.

Fig 214

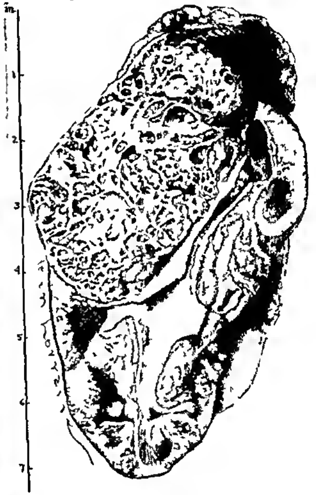

Fig 215

Fig 214.—Pyelogram left kidney showing pressure defects resulting from renal tumor.

Fig 215.—Left kidney divided showing renal tumor growing from upper portion of anterior surface. Same case illustrated in Fig 214.

Diagnosis.—The most important factor in the successful treatment of renal tumors is early diagnosis. Unfortunately the most suggestive symptoms and signs rarely occur early in the disease. The cardinal symptoms pain, hematuria, and tumor were all present in only 40.74 per cent of 243 patients reported by Foulds. The average length of time since the first symptom appeared in this group was 26.47 months. It is evident therefore that tumor of the

kidney does not grow rapidly at first and it is not surprising that the percentage of cures is small in a malignant disease that exists two years before it is recognized.

The earliest symptom in the majority of cases is hematuria. The bleeding colors the entire urine and is often quite profuse It is intermittent in most cases and attacks last from a few hours to a week or longer Unfortunately the cessation of bleeding is often attributed to some form of medication and the patient is given a false sense of security until bleeding recurs; this may not be

Fig 216—Carcinoma growing from the lower pole of the right kidney

for weeks or months Bleeding was the first symptom noted in 46 per cent of the cases reported by Foulds and is reported by most others to occur in from 70 to 80 per cent some time during the course of the disease The location and character of the tumor largely influence the period at which bleeding occurs A tumor arising in the medulla will encroach upon the pelvis and produce symptoms earlier than one arising from the cortex and a tumor arising from the midportion of the kidney is recognized because of hematuria or pain much earlier

Fig. 217.—Distortion of right renal pelvis from renal tumor

Fig. 218.—Multiple pulmonary metastases from renal tumor. Same case as illustrated in Fig. 217

than one arising from a pole of the kidney. Tumors of the lower pole of the kidney may become quite large before encroaching upon the renal pelvis sufficiently to cause hematuria or characteristic changes in the pyelogram.

Bleeding, particularly intermittent bleeding, is the most significant evidence of renal tumor and should always lead to a thorough investigation of the urinary tract.

Pain occurs sometimes during the course of most renal tumors, and is complained of in about 80 per cent of cases The pain is usually a dull ache located in the loin or upper abdomen. It results from tension within the capsule of the tumor mass or from pressure on adjoining structures. The discomfort is similar to that often experienced by patients suffering from large branching calculi or hydronephrosis. Severe renal colic may result from the passage of blood clots.

Fig 219—Distortion of right renal pelvis from sarcoma near the lower pole of the kidney

A mass in the loin or upper quadrant of the abdomen is the most positive evidence of renal tumor. It is a relatively late symptom, however, and the chances of cure are much better if the diagnosis is made before the tumor can be recognized by palpation. The presence of a palpable mass was the first symptom in only 9 per cent of the cases reported by Foley but unfortunately a mass could be felt in 59 per cent of the patients when they appeared for surgical treatment. Other authors report the presence of a palpable tumor in from 60 to 70 per cent of their cases.

A varicocele which develops rapidly is frequently mentioned as an evidence of a renal tumor. This is a late symptom and except in unusual or neglected cases the diagnosis should be made before varicocele occurs

It is evident that a reasonably early diagnosis will be made only when a thorough examination follows unexplained hematuria or pain in the renal area The majority of renal tumors occur between 40 and 60 years of age but no period of life is entirely exempt When patients are in the maximum tumor age it is more important than ever that a thorough examination be made whenever symptoms indicate a departure from normal in the physiology of the urinary tract Careful and repeated examinations of the urine will often show red blood cells and a trace of albumin between periods of gross bleeding or when no bleeding has occurred Careful palpation of the renal areas will at times

Fig 2 0—Longitudinal section through sarcomatous kidney Note almost complete replacement of renal tissue

indicate a sense of fullness if not an actual mass on the affected side The total renal function is rarely helpful in early cases—there is then no change in the function of the involved kidney As the disease progresses the opposite kidney if normal hypertrophies to assume the function of the diseased kidney

The cystoscopic examination aided by x ray of the kidney and pyelogram is the only method by which an early positive diagnosis of a tumor can be made (Figs 56 and 57)

It is important to examine the patient when bleeding. There is then no further doubt as to the source of the hematuria and repeated examinations can be made until the cause of the bleeding is determined. It has previously been stated that in the early period of the disease the function of the kidney is not disturbed but if a differential function test shows diminished excretion by one kidney, especially if that kidney is the source of bleeding, it is added evidence of destructive renal pathology. In well prepared patients a plain x-ray film is often helpful by showing enlargement or irregularity in contour of the renal shadow. The pyelogram is the most important single procedure and it should be bilateral so that the two pelves can be compared (Fig. 56). Minor variations from the normal can be more easily recognized; furthermore, congenital peculiarities are often bilateral and the presence of the same departure from the average normal on both sides is helpful in ruling out the probability of early tumor. The most frequent change in the pyelogram is the partial or complete obliteration of one or more calyces. Occasionally a calyx appears shorter than normal with some spreading of the minor calyces as if pressure is made upon the end of the calyx. This appearance is seen more often in cases of solitary cyst. In some cases of tumor the calyces are elongated and extremely thin. This picture somewhat simulates that found in polycystic disease, but in polycystic kidneys the changes in the pelvis are usually bilateral and usually the calyces are dilated and elongated. They do not appear pressed upon as in tumors The tumor at times invades the renal pelvis proper, causing distortion or the appearance of a filling defect. Such changes must be differentiated from a blood clot when there is bleeding at the time of examination or a history of recent bleeding. When pyelograms are made it is well to develop and examine the films before the catheters are removed, so that further pictures can be taken if necessary. Occasionally incomplete filling of the pelvis will give the appearance of a defect in one or more calyces. Intravenous pyelograms are helpful as a preliminary study of the urinary tract in suspected tumor but unless the changes are quite pronounced, it is usually necessary to repeat the examination by the retrograde method. When there is no enlargement of the renal shadow and the pyelogram is suggestive but doubtful, the examination should be repeated every two or three months until it is evident that no change is taking place in the kidney.

Tumors of the kidney must be differentiated from other enlargements of the kidney and from masses arising from adjoining structures. The most usual enlargements of the kidney to be differentiated are cysts and hydronephrosis. Solitary cysts are often difficult to differentiate. Hematuria is very rare and there is often a much longer history of a palpable mass. Frequently there is no evidence of encroachment upon the renal pelvis and rarely if ever complete obliteration of a calyx. One or more calyces may be distorted by pressure Operation is indicated in both diseases—consequently, differentiation before operation is of minor importance. A polycystic kidney can usually be differentiated by bilateral pyelogram for there are often similar changes in both kidneys even though only one is palpable The presence of hypertension, diminished kidney function, and other changes similar to chronic nephritis are also helpful in making a diagnosis. Masses arising from adjoining structures may be dif-

ferentiated by the pyelogram, which is usually unaltered although the kidney may be pushed from its normal location and the course of the ureter altered Enlargement of the spleen is recognized by palpation and by examination of the blood, which is often characteristic Large tumors of the adrenal gland are rarely differentiated from renal tumors until they are exposed at operation, though constitutional symptoms may be suggestive

Treatment—Nephrectomy and radiation are the present methods of treating tumors of the adult renal parenchyma Radiation should be considered as an accessory to surgical treatment and as a palliative measure in definitely inoperable tumors Tumors of the kidney vary greatly in their sensitivity to radiation The tumor may be greatly reduced in size, but there is no instance in which a cure has been effected except by removing the kidney Bothe has shown that, following irradiation of mixed tumors there was a definite destruction of the embryonal connective tissue cells but little or no effect upon the better differentiated epithelial cells

Irradiation is advocated almost universally in the palliative treatment of inoperable tumors of the kidney and for the treatment of metastases occurring after nephrectomy The size of the tumor is often reduced and the patient made more comfortable A few cases have been reported in which the patient lived several years following such treatment and occasionally a tumor believed to be inoperable is so reduced in size that nephrectomy can be done Recently, irradiation has been advocated both preoperatively and postoperatively with the hope of reducing operative and postoperative mortality Probably the first paper advocating preoperative irradiation was by Waters, Frontz and Lewis (Southern Medical Journal, April, 1934) Since then many others, notably Wharton, have advocated this method of treatment in well advanced tumors

The advantages of preoperative irradiation are reduction in the size of the tumor and a decrease in the vascularity, therefore facilitating nephrectomy It is also claimed that metastasis is minimized At present there is no evidence that the number of permanent cures has been appreciably increased by this method of treatment The routine use of preoperative irradiation causes considerable delay A period of at least two months is required from the beginning of treatment until the tumor can be removed This loss of time may permit metastases to occur rather than prevent them, furthermore, pronounced reduction in the size of the tumor at times causes the patient to refuse nephrectomy until the mass has reappeared It seems logical at present to reserve preoperative irradiation for those cases believed to be too large or too fixed to remove with a reasonable degree of safety In the majority of cases prompt nephrectomy is the treatment of choice

Postoperative irradiation is indicated in those cases in which the tumor is found at operation to have invaded adjacent structures or when the capsule of the tumor is ruptured during operation There seems to be no logical reason for irradiation when the growth is well encapsulated and is removed intact X ray treatment in cases in which tumor tissue is known to be left rarely delays the growth for a very long period

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The prognosis in renal tumors is not very favorable. The immediate mortality is considerably higher than that of nephrectomy for other diseases. The reported mortality of nephrectomy for renal tumors according to published statistics averages about 19 per cent. Foulds in 1924 reported 11 per cent mortality in 200 nephrectomies for tumor at the Mayo Clinic. During the same period 43 cases were not submitted to operation. Doubtless the variation in mortality in different groups of cases is to a considerable extent influenced by the selection of cases for nephrectomy. The life expectancy following operative recovery is influenced in the same manner. Patients with large, rapidly growing tumors or ones who have recently lost weight and strength whether or not metastasis can be recognized, are poor risks, both immediate and ultimate. Hand and Broders found that of 193 cases of carcinoma of the renal cortex operated upon at the Mayo Clinic from January 1, 1901, to December 31, 1923, and traced up to January 1, 1929, 149 were dead and 44 (23 per cent) were living—23 (11.9 per cent) died in the hospital. Of the 170 patients who left the hospital 126 (74.11 per cent) were dead and 44 (25.88 per cent) were living. There were 50 deaths in the first year following operation and 97 died in the first five years. Those patients in whom the capsule of the tumor was broken through at the time of operation or in whom the perirenal tissues were involved lived slightly more than half as long as those in whom the capsule remained intact and there was no perirenal involvement. The degree of malignancy of the tumor was also a deciding factor in the life expectancy following nephrectomy. Of the 44 patients who survived more than seven years the majority had tumors graded 1 and 2 (Fig. 221).

In a more recent report from the Mayo Clinic, James Priestley found that of 482 patients operated upon for adenocarcinoma of the kidney the survival rates for three-, five- and ten-year periods were 47.7 per cent, 38.4 per cent, and 27.3 per cent, respectively. It is therefore evident that postoperative survival has not increased very greatly in recent years and that a survival of from three to five years does not justify a conclusion that a cure has been obtained. The best criteria on which a prognosis can be based are the extent of involvement by the tumor and the grade of malignancy as recognized by the pathologist.

TUMORS OF THE RENAL PELVIS

Malignant tumors of the renal pelvis and calyces are similar to those arising in the ureter and bladder. With a few exceptions they consist of either papillary or squamous epithelial cancers. They are rare as compared with malignant tumors of the renal parenchyma. Mackenzie and Ratner estimated that not more than 7 per cent of renal tumors originated in the pelvis. Of 642 patients with renal tumor reported by Priestley, 62 had tumors of the renal pelvis. When it is recalled that squamous cell tumors are rarely diagnosed before operation and that they are often associated with prolonged renal infection or calculi, it is highly probable that many such tumors are overlooked in hospitals where careful pathological examination is not made routinely.

It is generally considered that nephrectomy in the presence of metastasis is a questionable procedure. This is true in most cases but if only one operable metastatic lesion can be located, removal of both the kidney and the metastasis may be accomplished with a chance of cure. Barney has reported a case in which a patient lived ten years following nephrectomy and excision of one lobe of the lung. Other cases of prolonged survival have been reported in which a solitary metastasis was proved by autopsy.

When performing nephrectomy for renal tumor, a wide exposure is necessary to avoid injury to adjoining structures, and to admit easy access to the renal pedicle. The transabdominal incision, pages 150-151, gives a satisfactory exposure and permits the renal pedicle to be ligated with much less manipulation of the tumor than is possible by most lumbar incisions. In most cases the Nagamatsu incision, pages 148-150, gives excellent exposure. A

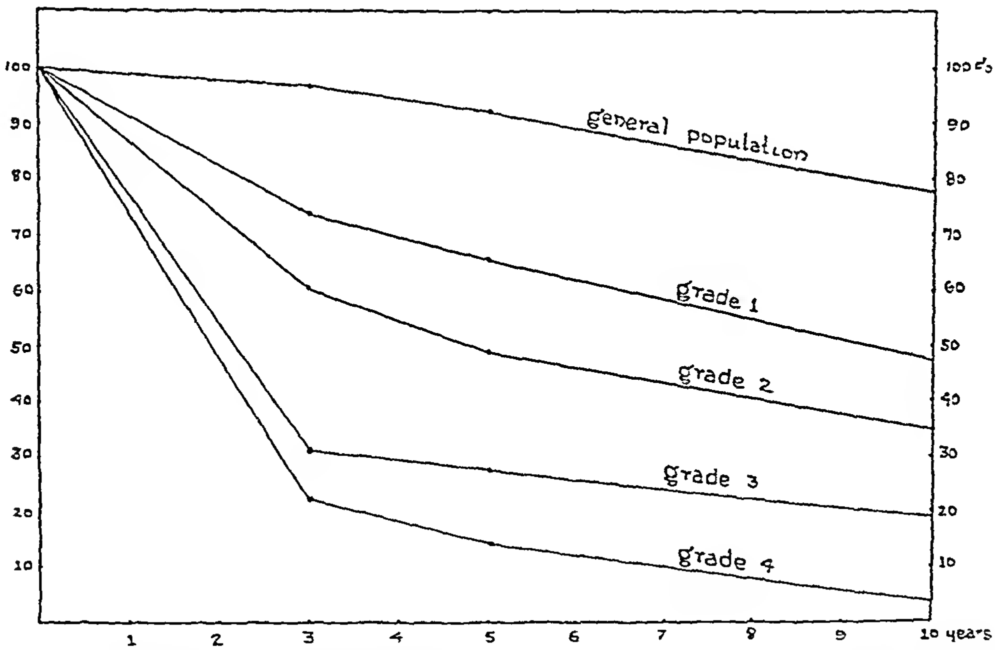

FIG. 221 —Chart showing survival according to grade of malignancy in cases of renal adenocarcinoma. (Priestley. Journal of the American Medical Association, September, 1939.)

wider exposure is possible with much less retraction, and the incision is almost directly over the renal pedicle. When the tumor is not excessively large and grows from the lower pole of the kidney, the usual lumbar incisions are satisfactory. In all cases, it is important to ligate the pedicle before freeing the kidney. It prevents squeezing tumor particles into the circulation, and greatly reduces bleeding during operation.

If the operation is prolonged, 5 per cent dextrose in Ringer's solution or normal saline should be administered during the operation. The blood pressure is thus sustained and postoperative shock is minimized. In debilitated or anemic patients a blood transfusion the day before operation is very helpful. Transfusion should be given following operation if there has been considerable blood loss or if shock occurs

sults from a carcinogenic irritation and represents a multiplicity of origin rather than direct implantation Cases have been reported in which similar tumors appeared in the opposite ureter

These tumors are similar in structure to papillary tumors of the bladder and vary from a low grade of malignancy (Figs 223 and 224) to those which

Fig 223 —Hydronephrosis from multiple papillomas of the ureter Apparently the tumor arose originally in the renal pelvis

actively invade the renal parenchyma (Figs 225 and 226) They grow slowly and are not often associated with pre existing pathological lesions such as renal infection, stones, or leukoplakia

Diagnosis—Squamous cell tumors produce no characteristic symptoms Blood cells may be found in the urine but macroscopic hematuria is rare There

Squamous cell cancer of the renal pelvis apparently results from chronic irritation. It is frequently associated with leukoplakia (Fig. 222), renal infection or stone. In many cases there is a history of renal infection extending over a number of years. In some cases the tumor invades the renal parenchyma early and the kidney is a compact mass of carcinoma and fibrosis. The pelvis is thickened and fixed by the malignant growth and there is frequent involvement of the renal pedicle and adjacent glands In other cases the renal pelvis is dilated and thickened, the ureter is partly or completely occluded, and the parenchyma of the kidney is thin and fibrotic. Tumor masses often cover and infiltrate a large portion of the pelvic wall. Areas of leukoplakia may be associated with the cancer.

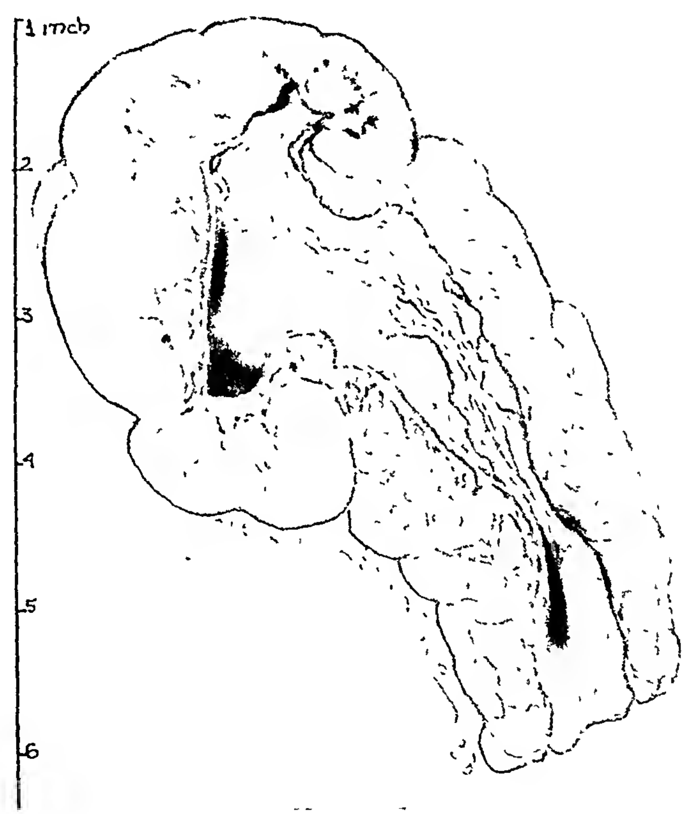

Fig 222—Leukoplakia of renal pelvis

Squamous cell cancers metastasize early, chiefly to the adjacent lymph nodes and to the liver. Metastases are also found in the bones and other organs

Papillary tumors constitute about three-fourths of renal pelvic growths. They tend to be multiple and occur more frequently in the male than in the female. Papillary tumors frequently involve other parts of the urinary system, notably the ureter and bladder on the corresponding side The appearance of tumors in the ureter and bladder accompanying tumors of the renal pelvis is usually spoken of as implants or transplants to the ureter or bladder. It is probable, as suggested by Keyes, that the multiplicity of these tumors re-

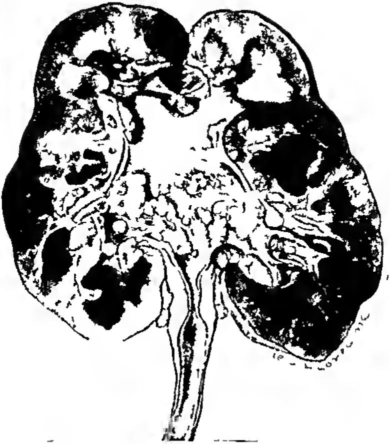

Fig 225 —Adenocarcinoma involving the right renal pelvis

Fig 226 —Photomicrograph of carcinoma illustrated in Fig 225 (Reduced from ×175)

may be pain of a dull aching character such as occurs in chronic pyonephrosis or staghorn calculi. Not infrequently there is a history of prolonged "kidney trouble." The only patient with squamous cell carcinoma of the renal pelvis that I have observed gave a history of several years' standing of pyuria and a dull ache in the loin upon exertion. Shortly before entering the hospital the pain had become much more constant and severe. There was death from metastasis to the liver within six months. There may be gradual occlusion of the ureter with the production of a painless hydronephrosis. In these cases a palpable mass is often the first evidence of the disease.

Fig. 224—Photomicrograph of tumor illustrated in Fig 223. (Reduced from ×150)

Upon examination there is always impairment of the function of the involved kidney. Frequently, as with the patient just mentioned, the functional value of the kidney is entirely destroyed A pyelogram will show great distortion of the renal pelvis. The calyces may be obliterated or completely effaced In some cases infiltration of the orifice of the calyces with dilatation above gives the appearance of cavity formation similar to the pyelogram of a tuberculous kidney. The pyelogram may give the appearance of far-advanced pyelonephritis. Stones are often present and the diagnosis may be renal calculi. When the ureter is completely occluded no fluid will enter the renal pelvis from below and if there is a mass in the loin the preoperative diagnosis is usually hydronephrosis The presence of a renal tumor is rarely suspected before the kidney is removed

The most common symptom in papillary tumors is hematuria Bleeding may occur at any stage of the growth. It is generally profuse, often accom-

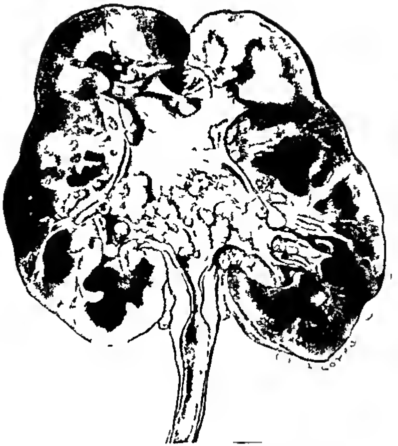

Fig 225 — Adenocarcinoma involving the right renal pelvis

Fig 226 — Photomicrograph of carcinoma illustrated in Fig 225 (Reduced from ×175)

panied by the passage of clots. It may be intermittent or may persist for several weeks. In some cases the bleeding is sufficiently profuse to require nephrectomy to prevent exsanguination. Pain when present may be dull and constant, resulting from obstruction of the renal pelvis, or there may be attacks

Fig 227—Pyelogram with filling defect in the upper calyx, caused by papillary tumor

Fig 228—Filling defect in left renal pelvis, from papillary tumor

of renal colic associated with the passage of blood clots. If cystoscopic examination reveals a tumor of the bladder with unilateral renal hematuria, the most probable diagnosis is renal tumor with a metastatic or co-existent tumor in the bladder. Tumor fragments are occasionally passed in the urine. Hydro-

nephrosis occasionally results from occlusion of the renal pelvic orifice or the ureter and a mass in the loin may be the first symptom. A patient came under my observation several years ago complaining of hematuria and a mass in the abdomen. Cystoscopic examination showed many papillary tumors in his bladder. There was no evidence of function from his left kidney. The left ureter could not be catheterized. At operation there was an enormous hydronephrosis with a few scattered papillomas attached to the dilated pelvis. The ureter throughout its length was so packed with papillary tumors that it had the appearance of a sausage (Fig. 223). Except in very early cases there is some

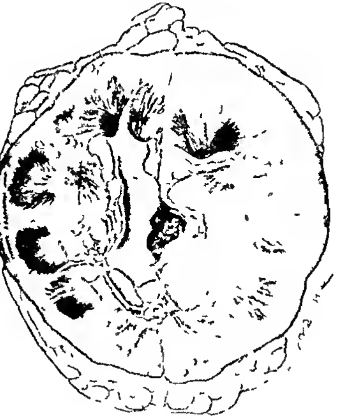

Fig. 229.—Papillary tumor. The same case illustrated by pyelogram in Fig. [illegible]

diminution or complete destruction of renal function. When the diagnosis is made preoperatively it is because of the pyelogram which shows a dilated, distorted renal pelvis with a filling defect in the contrast material (Figs. 227, 228, and 229). In some cases a calyx is obliterated by the base of the growth. The distortion of the renal pelvic outline is much less pronounced than in tumors of the renal parenchyma and the kidney is very slightly enlarged unless there is ureteral occlusion. Blood clots may produce filling defects similar to pelvic tumors. If the kidney pelvis is abnormal, it is well to repeat the pyelogram several days after the bleeding has subsided.

Treatment.—When there is a probable diagnosis of tumor of the renal pelvis, nephrectomy should be done immediately. As squamous cell cancers are often preceded by prolonged renal infection or stone, nephrectomy should be done when there is pyelographic evidence of renal pelvic deformity and diminution of renal function, provided the opposite kidney is in good condition. As this neoplasm metastasizes early and produces no characteristic symptoms, any cures that are obtained will be in cases in which nephrectomy is done before the presence of cancer is recognized

Papillary tumors grow more slowly than squamous cell tumors and because of bleeding at least a tentative diagnosis is likely to be made even in the more malignant growths while the tumor is still confined to the urinary tract. Because of the frequency with which these tumors are implanted or occur simultaneously in the kidney, the corresponding ureter and the bladder, it is advisable that the ureter and a section of the bladder surrounding the ureteral orifice be removed with the kidney. If the condition of the patient will not permit the complete operation at one time, the ureter and a portion of the bladder should be removed soon after the nephrectomy (nephroureterectomy, pages 335-336).

The prognosis is very poor in squamous cell cancers. Very few cures have been reported The outlook is more hopeful in papillary tumors Recurrences are to be expected if the corresponding ureter is not removed. Coexisting tumors in the bladder are often very troublesome and may cause a fatality even when the kidney and ureter have been removed successfully. Of 62 patients with epithelioma of the kidney pelvis reported by Priestley only 10.5 per cent were living after ten years. No distinction was made between squamous cell malignant tumors and papillary tumors

TUMORS OF THE RENAL PARENCHYMA IN CHILDREN

Tumors of the kidney are probably the most frequent malignant growths that occur during childhood With few exceptions these are of embryonal origin and are designated as adenomyosarcoma, or Wilms' tumor. Adenocarcinoma, although occasionally reported, is extremely rare in the early years of life. Benign tumors, rhabdomyomas, leiomyomas, adenomas, and fibromas occur at any age. They are frequently multiple and are not often of sufficient size to be of clinical importance. Neuroblastomas and retroperitoneal embryomas of renal anlage origin arise adjacent to the kidney and frequently cannot be differentiated from renal tumors prior to operation

Embryonal Adenomyosarcoma (Wilms' Tumor)

Wilms' tumor is a disease of early childhood. It has been occasionally reported in the adult but usually it appears before the fifth year of life. Embryonal adenomyosarcoma has been observed in the newborn and is rarely encountered after fourteen years of age. The distribution between the sexes is about equal and there is no apparent difference in the side involved. In a few instances bilateral involvement has been encountered.

These tumors may arise from any portion of the kidney although the majority probably come from the lower pole (Fig 230) The tumor may be smooth or nodular and is surrounded and separated from the renal tissue by a tough fibrous tissue capsule The kidney is displaced and distorted by pressure Late in the disease the capsule may be perforated and the renal tissue invaded (Figs 231 and 232) On section the tumor presents a glistening appearance and varies in color from whitish gray to brown There may be regions of hemorrhage or necrosis Histologically there is glandular tissue intimately associated with cells that closely resemble those of fibrosarcoma or myosarcoma

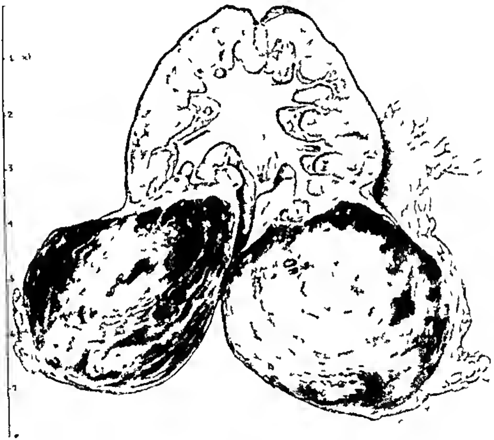

Fig 230 —Wilms tumor of the kidney following intensive x ray treatment Child was alive nine years following nephrectomy

Pyelograms of this case Figs 233 & 234

There are often areas of smooth or striated muscle and occasionally fat and cartilage Wilms' tumors have a fibrous stroma and frequently one type of tissue predominates to such an extent that the teratomatous nature of the tumor may not be recognized

Diagnosis —The diagnosis of Wilms' tumor is rarely difficult after symptoms appear Unfortunately these tumors grow rapidly and are well advanced before any inconvenience or discomfort is caused A mass felt in the renal area or visible enlargement of the abdomen is usually the first indication of the tumor in children It is usually found by the child's mother or nurse and in

Fig 231 —Wilms' tumor of the kidney Kidney removed after a very limited amount of x-ray treatment

Fig 232 —Photomicrograph (reduced from ×175) of the tumor illustrated in Fig 231.

most cases is quite large before it is noticed. Occasionally the tumor is found by the physician when examining the child because of hematuria, abdominal pain, unexplained fever or gastrointestinal disturbance.

Some pain is complained of in about a third of the cases because of pressure or traction on the renal pedicle. Backache or referred pain may result from metastasis. Kidney colic occasionally results from the passage of blood clots. Fever occurs in about half of the patients. It may be of low grade, and continuous or intermittent, reaching a rather high level at some time during the day. Fever may occur at any stage of the disease but is of very little diagnostic aid. Gastrointestinal disturbances are late and result from pressure or toxic absorption. Poor appetite, nausea and vomiting are never of diagnostic importance except to indicate a rather advanced stage of the disease.

Fig. 233

Fig. 234

Fig. 233.—Pyelogram showing distortion of the renal pelvis and displacement of the ureter by a large Wilms' tumor.

Fig. 234.—Same case as illustrated in Fig. 233 following extensive x-ray treatment. Pyelograms in Figs. 233 and 234 are of the same case illustrated by specimen in Fig. 230.

Hematuria occurs in only 15 to 20 per cent of cases and is usually a late symptom, in contrast to the relatively early bleeding in about 80 per cent of renal tumors in the adult. Wilms' tumor rarely invades the kidney pelvis and then only late in the disease. Some bleeding is said to result occasionally from congestion of the kidney. A mass in the loin or upper abdomen must be differentiated from extrarenal tumors and from hydronephrosis and renal cysts. The most frequent causes of a mass in the renal area, other than renal tumor, are neuroblastoma and hydronephrosis. A neuroblastoma is rarely as large when first recognized as Wilms' tumor, and the mass protrudes in the posterior

iliocostal space. A pyelogram will show the kidney pressed downward and usually with considerable distortion of the renal pelvis A tumor of the kidney protrudes into the abdomen and is first recognized as an abdominal mass. It can be palpated in the iliocostal area but does not produce a visible protrusion there as does neuroblastoma. Hydronephrosis is not unusual in children. The mass may be quite large and may develop with very little discomfort. On palpation hydronephrosis is apt to be less resistant than a solid tumor although when quite tense the differentiation cannot be positively made by palpation. Solitary

Fig. 235—Distortion of the left renal pelvis and ureter from Wilms' tumor growing from the upper pole of the left kidney

cysts of the kidney are rare in children and cannot be positively differentiated from either hydronephrosis or tumor except by x-ray examination Polycystic disease is usually bilateral although only one kidney may be palpable. The pyelogram is necessary for positive differentiation Enlargement of the spleen is rarely very confusing The sharp edge of the spleen and blood changes that accompany diseases of the spleen are usually helpful in the differential diagnosis Tumors arising from retroperitoneal lymph nodes must occasionally be dif-

ferentiated from renal tumors They rarely protrude so much into the abdomen, are fixed and do not move with respiration They may displace the kidney and ureter but the pyelogram will usually show that the kidney is not involved

The urogram, either intravenous or retrograde, is the only method by which an accurate diagnosis can be made in most cases

Excretory urography is very helpful If the diseased kidney has not been too severely damaged, a sufficient outline of the pelvis may be obtained to make a positive diagnosis In any case the condition of the opposite kidney can be determined In very young children good excretory urograms can often be ob

Fig 236 —Same case as illustrated in Fig 235 following extensive x ray treatment

tained by giving the contrast drug subcutaneously Excretory urography is harmless except in children with allergic conditions This should, of course be determined before administering the drug Retrograde pyelograms give a more accurate outline of the renal pelvis and ureter, and the condition of the opposite kidney can be accurately determined by the administration of indigo carmine or phenolsulphonephthalein but in small children a general anesthetic must be given and this is a definite disadvantage, particularly when another anesthetic must be given in a short while to remove the tumor In any case it is desirable that as accurate a diagnosis as possible be made before treatment is begun

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favorable immediate response of these tumors to x ray therapy Priestley and Broders report that a group of patients who were treated by irradiation and nephrectomy lived approximately twice as long as those who were treated by operation or irradiation alone This, however, does not indicate that irradiation has materially increased the ultimate results Of four apparent cures reported by Dr Priestley to Dr William E Ladd in a personal communication November, 1937, one had had no irradiation and two others were given x ray treatment only postoperatively Randall, Campbell, Barringer and many others have presented interesting reports on the use of irradiation as an adjunct to nephrectomy In one of Randall's patients an apparently inoperable tumor was so reduced in size that nephrectomy was successfully done and when the child died of pneumonia two years later a careful necropsy failed to show any evidence of local recurrence or metastasis

Roentgen therapy markedly reduces the size of the tumor in most cases and as a consequence the operation is less difficult and the immediate mortality is reduced It does not, however, destroy all the malignant cells Almost without exception pathological reports of tissue examined following irradiation have called attention to the presence of active tumor cells even when the tumor has been reduced to a mass of necrotic debris (Figs 235 236 and 237) There is so far no very convincing evidence that irradiation reduces the incidence of metastasis The reduction in the size of the tumor permits it to be removed with less manipulation and this should make the dissemination of tumor cells at the time of operation less probable, but the time required for irradiation and maximum shrinkage of the tumor—four to six weeks as a minimum—allows a considerable period for metastasis to occur between the diagnosis and the nephrectomy A study of reports available seems to indicate that metastasis follows nephrectomy preceded by irradiation about as frequently as nephrectomy alone Barringer states that the skin of children stands irradiation better than the skin of adults, but the general condition of children is more affected by it The most serious result is leukemia Loss of appetite and nausea may also be sufficiently severe to cause suspension of treatment When x ray therapy is being administered the child should be very carefully watched Frequent blood counts should be made and loss of weight and strength guarded against by an abundant diet and blood transfusions when required The treatment should be discontinued when the child's health continues to decline in spite of these measures *Barringer is of the opinion that irradiation should be given in smaller doses and over a longer period of time than has previously been the custom He mentions a child, McNeal's patient, who was given very low doses of high voltage x ray—200 kv for two or three doses then less than 100 kv for five months* The tumor disappeared Following this the child had several cycles of x ray treatment and 18 months after the institution of treatment had gained 11 pounds and was apparently well He also reported three other patients in whom the tumor has been controlled from eleven months to five years by x ray therapy alone All three patients were in good health at the time of his report

In cases of tumor the pyelogram will usually show that the kidney has been displaced and that the ureter takes an abnormal course often being carried beyond the midline of the body (Figs. 234 and 235). The axis of the kidney is changed in most cases and occasionally the kidney pelvis has been carried across the midline near the opposite kidney. The kidney pelvis is usually distorted, either compressed or dilated. One or more calyces may be elongated and constricted, or occasionally obliterated entirely. Shortening and broadening of the calyces are more often seen in cysts of the kidney than in tumor. Hydronephrosis does not often accompany the tumors, though there may be some dilatation of the pelvis from ureteral pressure. Hydronephrosis can be easily

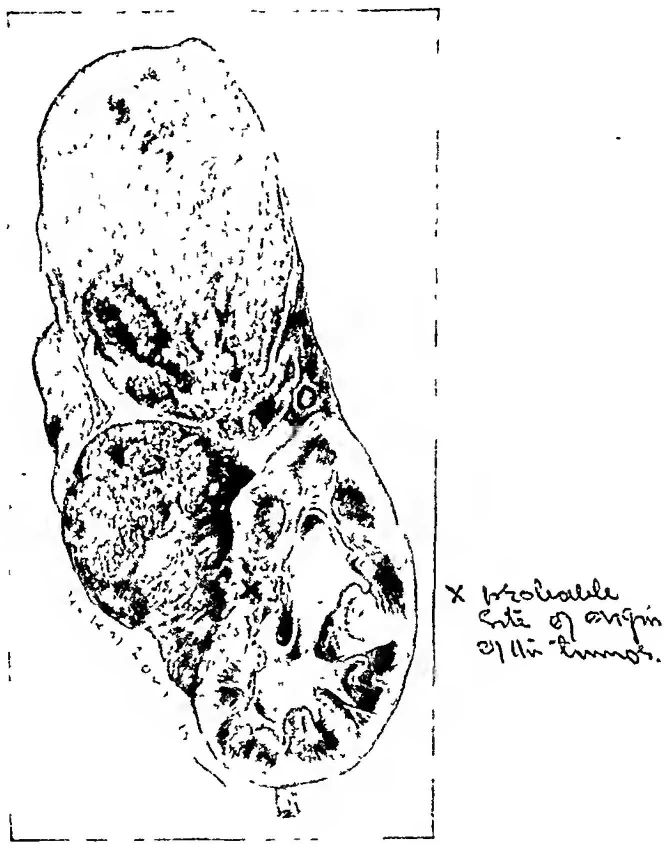

Fig 237 —Specimen removed from patient whose pyelograms are shown in Figs 235 and 236 Although the patient had had very extensive x-ray treatment, there were numerous areas of active malignant cells

differentiated from a tumor if a ureteral catheter will enter the renal pelvis. When the catheter will not enter the pelvis and the contrast substance runs back around the catheter the diagnosis is probably hydronephrosis. Displacement of the kidney and ureter without distortion of the renal pelvis suggests retroperitoneal tumor from some other source than the kidney.

Treatment.—Preoperative irradiation followed by nephrectomy and by postoperative irradiation is the plan of procedure that has been adopted by the majority of surgeons. This method of treatment has been adopted because of the very poor results obtained by nephrectomy alone and because of the very

before nephrectomy The small number of cures and the lack of standardization of both surgical and irradiation therapy make it difficult to determine the best plan of treatment Some surgeons use a lumbar incision and some a trans peritoneal incision Some use no irradiation, some just sufficient to reduce the tumor to what they consider operable size, while others continue the irradiation to the tolerance of the patient As mentioned in the treatment of tumors in the adult, an incision should be made that gives easy access to the tumor and permits the vascular pedicle to be divided and ligated before the tumor is disturbed This with few exceptions, will be a transperitoneal incision fully described on pages 150 151

Fig 39 —Dr McIver s patient four and one half years following operation Patient received postoperative x ray treatment

Irradiation should be used as a palliative measure in those cases that have already metastasized and preoperatively in those cases in which the tumor is so large and fixed that successful primary removal is improbable When irradiation is begun it should be continued until the maximum amount of shrinkage has been obtained or as long as it is tolerated by the patient I see no justification for depending upon irradiation alone except in cases with known metastasis

Robert McIver has a patient living and well twelve years following nephrectomy with postoperative x-ray therapy (Figs 238 and 239). J. Shelton Horsley removed a Wilms' tumor in 1909. No x-ray treatment was given either preoperatively or postoperatively. The patient was in good health when last heard from twenty-five years after the operation.

Fig. 238 —Wilms' tumor of left kidney removed by Dr Robert McIver No preoperative x-ray treatment was given.

The largest series of apparent cures is reported by William E. Ladd. Of 45 cases fourteen were living at the time of the report, eleven of these were in good health from one and one-half to nineteen and one-half years following nephrectomy. None of these patients was given preoperative irradiation. He reported eight cases of probable cures from the literature and of these eight cases only three received preoperative irradiation. It is Ladd's opinion that the chance of obtaining a cure is greater by immediate operation with a minimum amount of examination, particularly palpating the tumor, than by delaying operation from three to six weeks in order to shrink the tumor by irradiation

CHAPTER XV

NEPHRECTOMY

Lumbar Nephrectomy, Subcapsular Nephrectomy, Nephroureterectomy, Transperitoneal Nephrectomy, Accidents During Nephrectomy

The indications for nephrectomy are discussed in detail under the several surgical diseases of the kidney Generally speaking, nephrectomy is indicated when a kidney is a menace to health and its removal will not reduce functioning renal tissue beyond that necessary to maintain adequate excretion of urine Such cases are encountered when the kidney is the site of a malignant tumor or progressive incurable infection, or has been completely destroyed by disease or injury Nephrectomy is occasionally necessary as an emergency measure to save life in cases of fulminating infection or of severe injury Except in malignancy and tuberculosis, surgical diseases of the kidneys usually can be controlled by less drastic measures

Anesthesia—The age, temperament and physical condition of the patient should be considered when choosing the method of anesthesia to be used Spinal anesthesia has many advantages, especially in robust, muscular patients The muscles are relaxed and the intestines are collapsed, greatly reducing the amount of retraction necessary for good exposure The blood pressure is somewhat reduced and bleeding is less troublesome, furthermore, there is usually less postoperative nausea The excessive fall in blood pressure, sometimes noted when spinal anesthesia is used can be controlled by the preoperative administration of ephedrine and the use of 5 per cent dextrose in Ringer's solution during the operation The solution is permitted to flow at a rate just sufficient to maintain the blood pressure at a safe level In long, tedious operations, regardless of the type of anesthesia, the administration of dextrose during the operation is very helpful in preventing shock Spinal anesthesia is not suitable for children or for adults who are extremely apprehensive, or who object to its use Avertin, with the addition of ethylene or nitrous oxide and oxygen, is a very satisfactory method of anesthesia The combination gives good relaxation, and it has the added advantage that the Avertin can be given in bed, thereby relieving the patient of the dread of entering the operating room I have used it routinely as an anesthetic for children Ether, either alone or in combination with nitrous oxide and oxygen or ethylene and oxygen, is probably the most widely used anesthetic It should not be used when there is evidence of respiratory disease or in the aged Nitrous oxide or ethylene in combination with oxygen may give adequate relaxation, especially if the patient is frail, with poor muscular development When one of these gases is to be used, the preoperative administration of phenobarbital or a similar sedative is helpful

Postoperative irradiation is logical and when well tolerated should be administered, particularly if there is any doubt that the tumor has been completely removed.

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as possible An inadequate incision requires more forceful retraction, consequently more trauma, and a greater probability of wound infection, and unsatisfactory exposure adds to the danger of injuring contiguous structures

Freeing the Kidney—The kidney may not be immediately recognized when the renal fossa is exposed Posteriorly the area seems to be filled with a varying amount of areolar tissue and fat, anteriorly the roof of the wound is the parietal peritoneum As the wound is retracted, an outline of the lower pole of the kidney can be seen as it moves with respiration beneath its protective coverings When the kidney is small and high, it must be sought by palpation posteriorly near the upper angle of the wound When the kidney is enlarged, it may fill the entire fossa and extend well into the abdomen

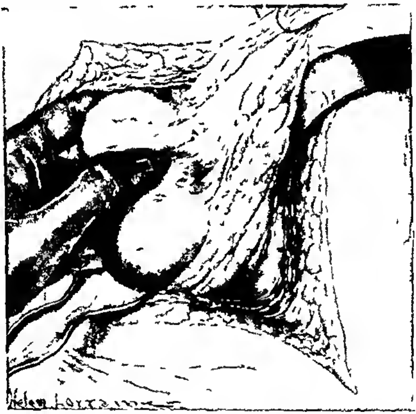

Fig 241 —The perirenal fascia has been divided near the hilum of the kidney posteriorly and is being separated from the kidney with the perirenal fat and retracted anteriorly

Although the operative procedure must of necessity vary according to the problems that arise in different cases it is much more satisfactory to follow as nearly as possible a systematic method of freeing and delivering the kidney It is well to begin the dissection in the most accessible area which is posterior to the kidney With the fingers the perirenal fascia is separated from the lumbar muscles and divided throughout its length as near the internal border of the kidney as is practical (Fig 240) I prefer to divide this fascia with scissors rather than tear it, as this makes a cleaner dissection The fascia together with the perirenal fat, is then detached from the kidney, chiefly by

LUMBAR NEPHRECTOMY

Incision.—Except when involved by large malignant tumors the kidney can be removed more safely and satisfactorily through a lumbar incision. Either of the incisions described on pages 136-148 may be used, depending upon the size of the kidney, the physique of the patient, and the preference of the surgeon. A curved incision, beginning near the lumbocostal angle and ending above the anterior-superior spine of the ilium, is usually preferred and gives satisfactory exposure in most cases. If the patient is thin and the kidney is small, a straight incision from the costal margin along the border of the

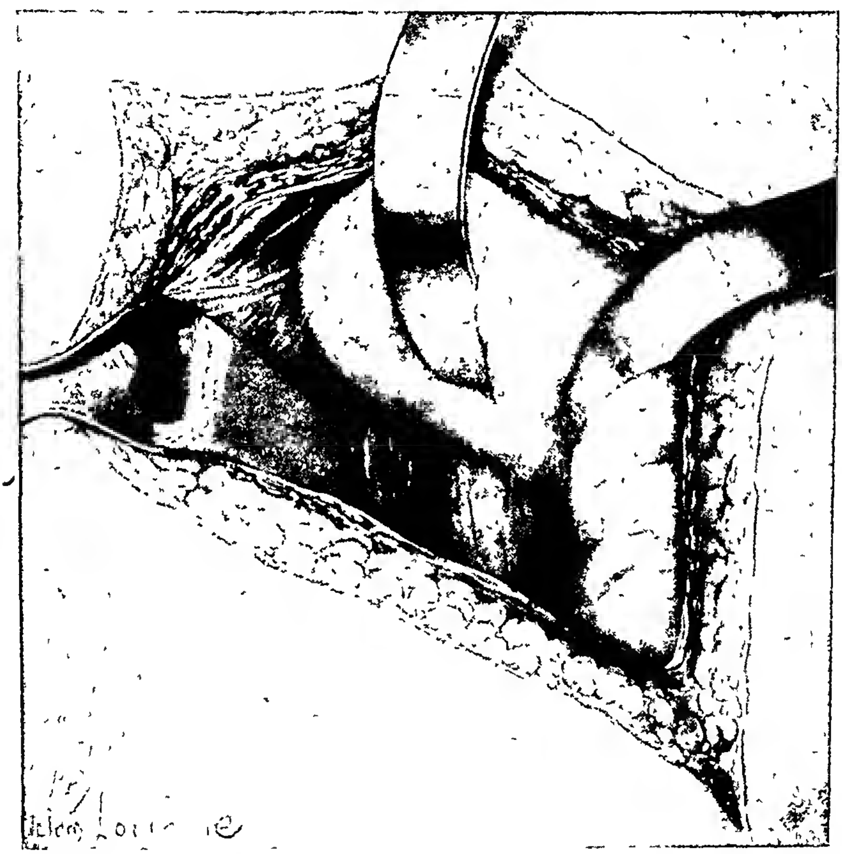

Fig 240—Exposure of the kidney The perirenal fascia is separated from the lumbar muscles and retracted with the kidney medianward

lumbar muscles to the crest of the ilium is adequate and there is less post-operative discomfort. When there is little space between the costal margin and the crest of the ilium, or when the kidney is enlarged, resection of the twelfth rib adds greatly to the ease of exposure. The incision may be extended beyond the tip of the rib as far as necessary. All important nerves are well out of the way and the incision is almost directly over the renal pedicle. The incision selected should be made sufficiently long to give free access to the kidney and to permit as much of the operation to be done under direct vision

pole, being held taut, are identified more easily and divided. Adhesions to the upper pole of the kidney should be divided between hemostats, and the stump distal to the kidney should be ligated. When these adhesions are separated by blunt dissection, troublesome bleeding may be caused by tearing polar vessels which, when they retract beneath the diaphragm, are difficult to reach. Adhesions vary greatly in extent and density, depending upon the extent and duration of the disease. As the lower pole of the kidney is elevated, the adhesions are divided close to the kidney and as the dissection approaches the hilum of the kidney the ureter is identified and dissected free to the lower extremity of the wound where it is doubly clamped and divided. If the ureter is infected, it is well to cauterize the cut ends with phenol. If the kidney is tuberculous, one or two cubic centimeters of phenol should be injected into the lumen of the lower segment. Gentle traction is made on the ureteral stump by the attached hemostat and the dissection is continued beneath the renal pelvis until the vascular pedicle is reached. The kidney is then retracted downward and the costal border is retracted upward while adhesions to the upper pole are divided. When the vascular pedicle can be exposed easily from below, it may be clamped and divided before freeing the upper pole. This is definitely helpful when adhesions are very dense in this area. When the kidney is densely adherent above, I have found it advantageous to separate the capsule from the upper pole and leave it attached to the adhesions. This, of course, cannot be done if an abscess occupies the upper pole and should not be done in malignancy.

The above description of freeing the kidney implies that disease has not invaded the perirenal structures to the extent that the normal anatomical relations have been greatly distorted. In some cases the perirenal fat and fascia are so adherent that they cannot be accurately separated and occasionally they are so fused that they appear to be a part of the wall of the pyonephrotic cavity. When such cases are encountered, the dissection should begin posteriorly as previously described, separating the entire mass from the lumbar muscles as completely as possible. The dissection is then continued from below by first identifying the ureter. The peritoneum is retracted medially and the ureter is sought toward the medial border of the psoas muscle. It has not become attached to the peritoneum at this level. The spermatic or ovarian vessels run along the medial side of the upper portion of the ureter, but when there is extensive reaction they may be bound with the ureter in a mass of infiltrated fat. When the ureter is identified it should be doubly ligated and divided. Gentle traction is then made upward and outward on the proximal stump while the dissection is continued upward, carefully separating the parietal peritoneum from the kidney. It is usually less difficult to find a line of cleavage near the hilum of the kidney by following the ureter upward. The peritoneum is then stripped gently from the anterior surface from the hilum toward the convex border. Not infrequently the peritoneum is torn but no harm is done if the rent is promptly identified and sutured. With the lower pole and

blunt dissection, using the finger or a small gauze sponge to separate the light adhesions between the fat and the renal capsule. When adhesions are dense, they should be divided with scissors. When the dissection has progressed beyond the convex renal border, the kidney is grasped with one hand while the fat and fascia are separated from the anterior surface of the kidney (Fig. 241), care being taken to protect the adjacent peritoneum. Either pole is then

Fig 242—Adhesions to the lower pole of the kidney are divided between hemostats

liberated, depending upon the condition of the kidney. Usually, it is easier to free the lower pole of the kidney first (Fig. 242) but if the kidney is ptosed or if the disease is confined chiefly to the lower pole, it is easier to free adhesions to the upper pole first and to clamp or ligate and divide the pedicle. The kidney then can be drawn from the wound, and adhesions to the lower

pole, being held taut, are identified more easily and divided. Adhesions to the upper pole of the kidney should be divided between hemostats, and the stump distal to the kidney should be ligated. When these adhesions are separated by blunt dissection, troublesome bleeding may be caused by tearing polar vessels which, when they retract beneath the diaphragm, are difficult to reach. Adhesions vary greatly in extent and density, depending upon the extent and duration of the disease. As the lower pole of the kidney is elevated, the adhesions are divided close to the kidney and as the dissection approaches the hilum of the kidney the ureter is identified and dissected free to the lower extremity of the wound where it is doubly clamped and divided. If the ureter is infected, it is well to cauterize the cut ends with phenol. If the kidney is tuberculous, one or two cubic centimeters of phenol should be injected into the lumen of the lower segment. Gentle traction is made on the ureteral stump by the attached hemostat and the dissection is continued beneath the renal pelvis until the vascular pedicle is reached. The kidney is then retracted downward and the costal border is retracted upward while adhesions to the upper pole are divided. When the vascular pedicle can be exposed easily from below, it may be clamped and divided before freeing the upper pole. This is definitely helpful when adhesions are very dense in this area. When the kidney is densely adherent above, I have found it advantageous to separate the capsule from the upper pole and leave it attached to the adhesions. This, of course, cannot be done if an abscess occupies the upper pole and should not be done in malignancy.

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anterior surface of the kidney exposed, the dissection may be continued around the upper pole with very little trouble. It is important in these densely adherent kidneys to divide the adhesions near the kidney and to avoid undue traction. The pleura, diaphragm or peritoneum may be injured by forcefully separating such adhesions.

When the kidney has been operated upon previously, the old scar should be excised and the incision if possible should extend two or three inches beyond the lower end of the original wound. The perirenal space is first entered through this unscarred area. The incision is then extended through the muscles to, or beyond, the upper limit of the old incision. Frequently, there are very dense adhesions to the undersurface of the old scar. These should be divided as the incision is extended. If there is a fistulous tract in the scar, it should be circumscribed by the incision and removed en masse with the kidney if possible. A heavy forceps may be placed on the fistulous tract and when it is of long standing it may be used for traction The kidney should be separated first from the posterior abdominal wall. The peritoneum is then retracted medially at the lower angle of the wound and the ureter is exposed When this is found, the dissection is continued anteriorly as previously described

Tying the Pedicle.—The treatment of the vascular pedicle in nephrectomy is an exceedingly important part of the operation; first, because of the control of bleeding, and second, because if the nephrectomy is done for a malignant tumor of the kidney fragments of this tumor may project into the renal vein and if the pedicle is not carefully dissected and secured at an early stage of the operation, manipulation may dislodge some of the growth and force it into the renal vein. The many methods that have been advocated for securing the renal pedicle are an indication of the difficulties met in this stage of nephrectomy. Ligation of the vessels before dividing them is advocated by some surgeons This procedure has little to recommend it except in cases of malignancy where the vessels are exposed, ligated, and divided in an early stage of the operation. Cases in which the vascular pedicle is easily accessible before the kidney has been removed give little concern, and the vessels may be ligated before or after the kidney is removed, with equal ease and security When the kidney is enlarged or when the pedicle is short and infiltrated, or when the patient is obese, an effort to ligate the pedicle before it is divided and the kidney is removed is unnecessarily time-consuming and adds nothing to safety.

The following method of handling the vascular pedicle has been found satisfactory in most cases. As much fat as can be removed safely is dissected from the pedicle. The pedicle is then clamped with two slightly curved forceps placed about a centimeter apart. The large pedicle forceps are cumbersome and are rarely used. Forceps of the Kelly type with the serrations on the blade running lengthwise are preferable. If there is room, a third clamp is placed near the kidney to prevent soiling the wound when the vessels are divided. The forceps may be applied from above or below, depending upon which gives the more accessible approach. Ligatures are more easily applied

if all the forceps point in the same direction The points of the forceps should project just beyond the pedicle and should be placed under direct vision or careful finger guidance to be sure that the margins of the vena cava or of the duodenum are not included (Fig 243) The kidney is removed after severing the pedicle between the distal two forceps (Fig 244) or distal to the second forceps when only two are used A heavy catgut ligature is thrown around the pedicle beneath the proximal pair of forceps and is tied as the clamp is unlocked slowly so that it sinks into the groove made by the forceps A second ligature is similarly placed behind the distal forceps The first knot of these ligatures may be held by mosquito forceps to prevent slipping as the second

Fig 243—Three curved hemostats grasp the renal pedicle Dotted line indicates area at which pedicle is divided

knot is run down If the pedicle is cut close to the second forceps, the second ligature should be placed with a needle, transfixing the pedicle to prevent slipping of the ligature Both ligatures are of catgut, preferably No 1 plain, which is sufficiently durable for this purpose Chromic catgut occasionally is slow in absorbing and is sometimes the cause of prolonged drainage There is no need of ligating the vessels individually unless they are situated an unusual distance apart Individual ligation is necessary when there is an anomalous origin of the blood supply If, on account of the obesity of the patient

or the shortness of the pedicle, it is impossible to apply two forceps, one forceps may be used. The pedicle should be cut as far as possible from the forceps and transfixed and tied distal to the forceps first or, if one prefers, the individual vessels may be ligated distal to the forceps. A ligature is then placed behind the forceps as described above. If the vessels are injured and the bleeding is profuse, pressure with a large piece of dry gauze should be made immediately over the bleeding point. If this controls the bleeding, the edges of the gauze are gradually removed until the bleeding points are exposed and clamped. If the hemorrhage is arterial, the injured vessel should be seized with the fingers. Pulsations of the artery and of the blood stream will lead the fingers to the injured artery. A clamp can then be applied safely. It is a

Fig. 244.—Kidney attached only to ureter. Ligature placed around pedicle behind proximal hemostat. The hemostat is loosened as the ligature is tied and again closed on the pedicle. Two other ligatures are applied as the hemostats are removed. Usually the ureter is divided and the kidney removed from the wound before the pedicle is ligated.

great mistake to attempt to clamp blindly in this region and forceps should not be applied until the bleeding point has been accurately located. Injuries to the vena cava and to the duodenum from indiscriminate and blind clamping may occur and may be fatal.

Occasionally, in very obese patients, in inflammatory conditions when the pedicle is greatly infiltrated or when the patient is in poor condition and the pedicle is difficult to ligate, the clamps may be left on the pedicle and the wound is closed around them. For this purpose forceps that do not project very far above the surface of the wound should be used. Two for-

ceps should be placed as far apart as the length of the pedicle will permit. When there is difficulty in controlling bleeding from the stump, several forceps may be necessary. When forceps are left on, their handles should be protected carefully when dressing the wound. They may be removed in 48 to 72 hours. They should first be carefully unlocked and then left in place. After a few hours if no bleeding occurs they may be removed. I have seen this procedure used many times and have never seen bleeding occur when the forceps were removed.

SUBCAPSULAR NEPHRECTOMY

Occasionally, a kidney is so adherent to neighboring structures, particularly to the diaphragm and peritoneum, that a classical nephrectomy, if not impossible, is unnecessarily time consuming and hazardous. This condition is most frequently seen when the kidney has been operated upon previously, but may result from chronic inflammatory disease within the kidney or in the perirenal tissues. In such cases a subcapsular nephrectomy is indicated. This, of course, should not be done when malignancy is suspected, and is undesirable in tuberculosis, although permissible if removal of the kidney with its investing structures will prolong the operation beyond the estimated endurance of the patient.

The kidney is exposed by the usual lumbar incision. The external border is identified and the capsule is split longitudinally. The perirenal fascia, when too densely adherent to be stripped from the kidney, is included in this incision. The capsule is then stripped from the kidney down to the pelvis. The lower pole of the kidney is retracted upward and an incision is carefully made through the reflected capsule. With the capsule reflected from the kidney and the kidney retracted upward and outward, the incision is continued anteriorly, dividing the capsule as it is reflected from the hilum of the kidney (Fig. 245). The perirenal tissues are not so adherent in this area and it is usually possible after entering the perirenal space at the hilum to insert the finger behind the capsule and protect the pedicle and adjacent structures as the capsule is divided. After dividing the capsule around the hilum, the ureter is isolated and divided and the vascular pedicle is clamped and ligated. It is probably more frequently necessary and less dangerous to leave clamps on the pedicle in subcapsular nephrectomy. The blood vessels are often sclerotic and the blood flow is greatly diminished. If, because of difficult exposure or dense adhesions it is impractical to divide the capsule at the hilum, the kidney may be pulled up well into the wound and a heavy forceps placed on the pedicle over the reflected capsule. The pedicle is then divided as it enters the renal hilum. The forceps may be left in place two or three days, or the pedicle may be transfixed and ligated with heavy catgut. This method is not so satisfactory as that of exposing the pedicle thoroughly. There is more danger of bleeding and a portion of the renal pelvis is often cut away and left behind, resulting in prolonged drainage.

or the shortness of the pedicle, it is impossible to apply two forceps, one forceps may be used. The pedicle should be cut as far as possible from the forceps and transfixed and tied distal to the forceps first or, if one prefers, the individual vessels *may be ligated distal to the forceps A ligature is then placed* behind the forceps as described above. If the vessels are injured and the bleeding is profuse, pressure with a large piece of dry gauze should be made immediately over the bleeding point. If this controls the bleeding, the edges of the gauze are gradually removed until the bleeding points are exposed and clamped. If the hemorrhage is arterial, the injured vessel should be seized with the fingers. Pulsations of the artery and of the blood stream will lead the fingers to the injured artery. A clamp can then be applied safely. It is a

Fig. 244—Kidney attached only to ureter Ligature placed around pedicle behind proximal hemostat The hemostat is loosened as the ligature is tied and again closed on the pedicle Two other ligatures are applied as the hemostats are removed Usually the ureter is divided and the kidney removed from the wound before the pedicle is ligated

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NEPHROURETERECTOMY

Excision of the ureter, either partial or complete, is indicated in some cases. This subject has been discussed extensively by Robert Gutierrez who states that the operation is indicated in 18 per cent of nephrectomies, but very few surgeons employ the procedure as often as this. The operation is necessary in the treatment of operable malignant tumors of the ureter and should be done in cases of papillary tumors of the kidney even when no involvement of the ureter can be demonstrated. Inflammatory conditions of the ureter, including tuberculosis, will usually heal following nephrectomy if there is no interference with drainage. When there is obstruction of the ureter with dilatation and retention of pus or infected urine, nephroureterectomy is necessary. If a stone obstructs the ureter of a functionless kidney, removal of the stone may permit adequate drainage of the ureter, but if the ureter is greatly dilated it should be removed. Excision of the ureter adds little to the difficulty of the operation and assures a more complete cure. An inadequate ureteral valve with regurgitation of bladder urine into the ureter is an indication for ureterectomy when the kidney must be removed. A persistent urinary fistula may result if the ureter is not removed. Drainage of a megaloureter is never complete, and such greatly dilated ureters should be removed if nephrectomy is done. In all cases requiring nephrectomy the condition of the ureter should be determined preoperatively when possible, and when it is considered a probable source of irritation or infection, it should be removed with the kidney.

Operative Technique.—Excision of the ureter adds very little to the hazard of nephrectomy except in debilitated patients. A very satisfactory procedure is first to free the kidney except its attachment to the ureter. The ureter is then liberated well below the crest of the ilium and the nephrectomy wound is closed, leaving the ureter attached to the kidney projecting from the lower angle of the wound. A temporary dressing is applied to the wound and the patient is placed in the supine position preparatory to excising the ureter below. The lower end of the ureter is exposed retroperitoneally by an oblique or paramedian incision as described on pages 368-373. The ureter is identified and isolated as near the bladder as possible. A gentle tug on the projecting portion of the ureter by an assistant will aid in identifying it in the lower wound. If the ureter is removed because of a papillary tumor, a cuff of the bladder adjacent to the ureteral orifice must be removed also; otherwise, it is satisfactory to ligate doubly and divide the ureter as it enters the bladder. Both ureteral stumps should be disinfected with phenol. Liberation of the ureter is completed from below upward, and it is then drawn through the lower angle of the nephrectomy wound. Bleeding points that are accessible are clamped and ligated. A Penrose drain is placed near the stump of the ureter and the abdominal wound is closed.

It has been advised that a finger cot or the finger of a glove be tied over the end of the ureter to prevent contamination as it is drawn through the wound. This adds considerable bulk to the end of the ureter, and if it is tied securely and disinfected with phenol there is little probability of contamination. The ureter is usually ligated below the area of maximum infection.

Fig 245 —Subcapsular nephrectomy The capsule, densely adherent to the perirenal tissues, has been separated from the kidney and divided along the internal border, exposing the renal pedicle The nephrectomy is completed by clamping and dividing the pedicle and ureter

seen and ligated The pedicle of the kidney is approached if it is possible to do so before any attempt is made to mobilize the kidney The renal pedicle and pelvis are hidden by a layer of fat The pedicle can usually be recognized by the pulsation of the renal artery If it is difficult to locate the pedicle, the ureter can be identified (Fig 248) and traced up to the renal pelvis and the vessels identified as they course over this structure The fat is carefully dissected from the vessels They are ligated doubly, either separately or together (Fig 249) A clamp is then placed between the distal ligature and the kidney, and the pedicle is divided (Fig 250) This clamp may be left in place, or if

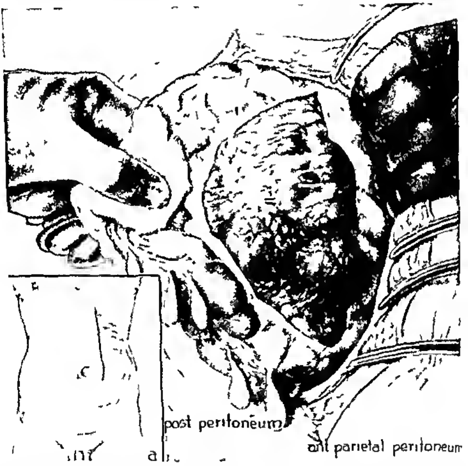

Fig 246.—Transperitoneal nephrectomy (left) Inset shows line of abdominal incision An incision has been made in the parietal peritoneum along the outer margin of the colon

there is room a ligature may be placed near the kidney and the forceps removed Regurgitation of blood from the kidney should not be permitted, as it may carry tumor cells into the wound If the pedicle is greatly infiltrated and the vessels are difficult to isolate, it may be divided between forceps and ligated as previously described After the pedicle is ligated the peritoneum covering the tumor is separated and reflected upward Any portion of the peritoneum that is adherent to the tumor is removed with the growth The ureter is isolated well below the kidney doubly ligated and divided (Fig 250)

If the surgeon prefers, the ureter may be divided and ligated as far from the kidney as possible through the nephrectomy wound and the rest of the ureter removed from below, either immediately or at a subsequent operation. Unless division of the ureter will aid in simplifying a difficult nephrectomy, this procedure has no advantage over the one just described.

Gutierrez advises reversing the operation by dividing and liberating the ureter before removing the kidney. He contends that there is less probability of contaminating the abdominal wound. This method has one definite disadvantage. Occasionally the condition of the patient may require that the operation be terminated as quickly as possible. In such a case it would be much better to have removed the kidney than the ureter. In cases of primary tumor of the ureter, the ureter should be removed first. for here the pathology requiring immediate attention is in the ureter.

The subject of ureterectomy is discussed more fully under disease of the ureter.

TRANSPERITONEAL NEPHRECTOMY

When the kidney is enlarged by a malignant growth, nephrectomy can often be done more satisfactorily through an anterior abdominal incision. By this method the tumor is clearly exposed, the renal pedicle can be ligated early in the operation without manipulating or freeing the tumor mass, and the tumor can be removed with the surrounding fat and fascia with less danger of injuring the vena cava or abdominal viscera Kidneys greatly enlarged from other causes are more easily removed transperitoneally, although there is not the same indication that exists in malignant tumors, and if the kidney is infected there is danger of peritonitis.

Ample exposure is given through an upper rectus incision. The incision is placed near the margin of the muscle and should extend from the costal margin to a point well below the umbilicus. If more room is needed, an oblique incision may be made from beneath the outer costal margin, downward and forward to the lower end of the rectus incision. A flap of the upper abdominal wall can then be turned upward, giving wide exposure to the tumor area, though with good relaxation such an extensive incision is rarely necessary The posterior peritoneum is incised just lateral to the colon. This incision in the posterior peritoneum should extend from below the lower pole of the tumor upward well above the flexure of the colon (Fig. 246). The colon with its mesentery is mobilized by gauze dissection, pushed toward the midline, and confined with the rest of the intestine to the opposite side of the peritoneal cavity by gauze packs and retractors. As the posterior peritoneum is dissected medially the area of the renal pedicle is exposed.

When operating upon the right side the duodenum is reflected with the colon and peritoneum (Fig 247). Usually the vena cava or aorta is partly exposed, depending upon the side that is operated upon Aberrant vessels can be

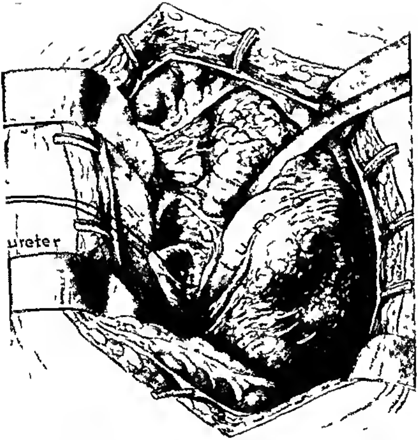

Fig 248—Transperitoneal nephrectomy (left) The colon has been liberated from the tumor mass and isolated with the rest of the intestines by gauze packs The peritoneal margins are held by hemostats The ureter is identified

Fig 247 —Transperitoneal nephrectomy (right) The intestines have been packed off with gauze sheets, and an incision has been made in the parietal peritoneum external to the colon, and the colon retracted medianward, exposing renal pedicle which is ligated and divided before freeing the kidney

are thrust through this skin incision and grasp a soft rubber tube about one third of an inch in diameter which is drawn into the wound The tube is fixed to the skin by a suture

The wound in the posterior parietal peritoneum is closed with a continuous suture of No 1 plain catgut The abdominal wound may be closed in layers The peritoneum and posterior sheath of the rectus muscles are sutured with

Fig 250—Transperitoneal nephrectomy (left) The renal pedicle is clamped and divided distal to the ligatures The ureter is ligated and divided Bleeding is now minimal and liberation of the tumor mass is relatively easy

a continuous mattress suture of No 1 chromic catgut, the muscles lightly approximated with a continuous suture of No 1 plain catgut, the external sheath of the rectus with a continuous lockstitch suture of No 1 chromic catgut, and the skin with interrupted sutures of silk Many surgeons prefer to close the abdominal wound with interrupted sutures of silkworm gut or Zytor

The kidney can then be mobilized with very little difficulty. The adhesions are quite vascular, often containing large, thin-walled veins These are seen easily and may be ligated and divided as they are approached. Aberrant vessels should be looked for and treated in the same manner. A line of cleavage is sought outside the perirenal fascia (Gerota's capsule), thereby removing as much of the perirenal tissue as possible. It is usually easier to begin the mobilization posteriorly and near the lower pole of the tumor. As a rule, the adhesions are not very dense and are easily separated by the fingers or a gauze sponge. Any resisting bands should be divided between forceps and ligated.

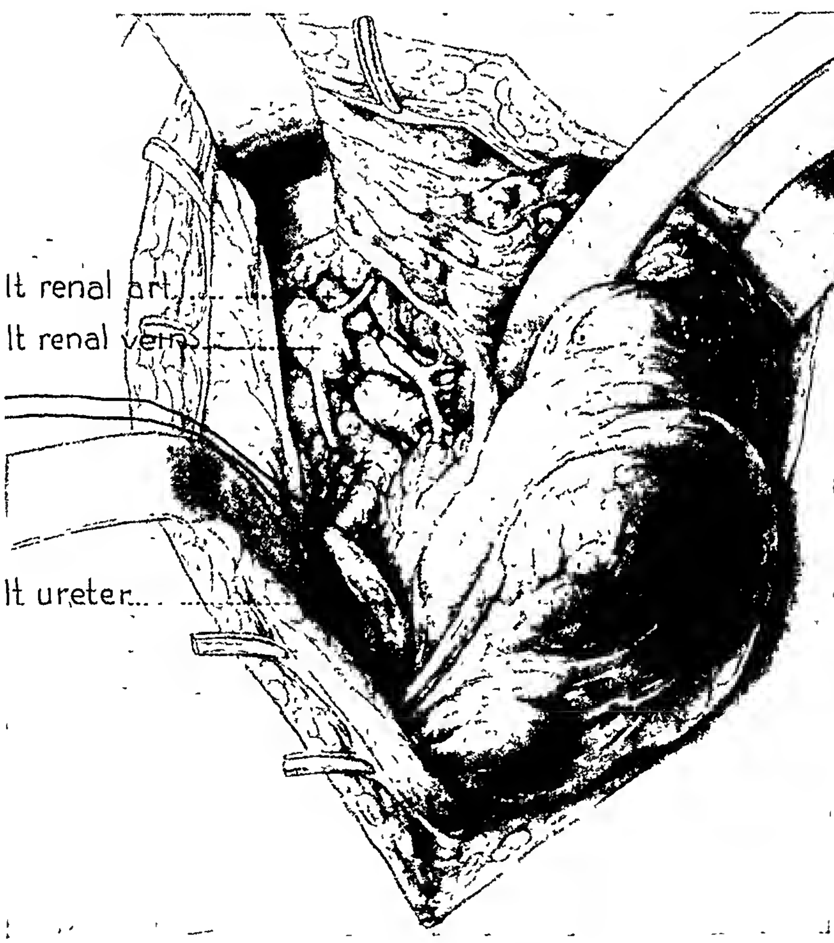

Fig. 219—Transperitoneal nephrectomy (left) By following the ureter upward, the renal vessels are identified and doubly ligated

The wound is carefully reviewed to see that no accidental injury has occurred and all bleeding points are secured with catgut ligatures. Drainage is established by inserting a pedicle forceps into the cavity left after removing the kidney and pushing the forceps through to the back just external to the margin of the quadratus lumborum until the skin is reached. The skin is then incised over the tip of the forceps after separating the blades and the forceps

(4) when the ligature cuts through a blood vessel Delayed bleeding may result from a slipped ligature, from a crushed blood vessel which was not tied, or may follow the removal of forceps which were left on to control bleeding When a blood vessel is torn while freeing the kidney, the pedicle should be clamped immediately and divided This usually controls the bleeding, which occurs most often from a vein injured near the kidney If the pedicle cannot be reached at once, a gauze sponge should be held firmly against the bleeding area until the pedicle can be exposed When the pedicle is lost, the area should be packed firmly with gauze and pressure should be made toward the spine Accumulated blood is then sponged out, good exposure is secured, and the gauze is slowly removed As the bleeding vessels come into view, they are clamped with forceps and ligated It is a grave error to attempt to sponge away blood in an effort to locate the bleeding vessels An excessive amount of blood is lost It is worse to clamp blindly in a pool of blood, as there is danger of injuring the great vessels or abdominal viscera The pedicle rarely slips from the forceps or ligature unless the pedicle is cut too near the forceps or the ligature is not securely tied When tying the ligature, if there is any doubt about the first knot holding, it should be held with a mosquito forceps until the second knot is tightened If the pedicle is short, the ligature should be placed with a needle, taking a small bite in the margin of the pedicle When the ligature cuts through a vessel, the next forceps that is placed to control the bleeding should be left in place and no further effort made to ligate the pedicle When the tissues are extremely brittle, ligatures may continue to cut through

Secondary bleeding rarely occurs It is important to examine the wound carefully after tying the pedicle Not only should the stump of the pedicle be examined to see that ligatures are tight, but the slightest trickle of blood should be traced to its source and a ligature applied if necessary Bleeding has been reported following the removal of forceps which were left on for hemostasis I have never seen it occur The forceps should be unlocked several hours before being removed, and then should be gently removed by the surgeon who applied them When secondary bleeding occurs, the incision should be opened sufficiently from the upper angle to pack the wound with gauze The patient should be taken then to the operating room and the bleeding vessel located and tied It is dangerous to depend upon packing for the permanent control of bleeding, however securely it is placed A transfusion of blood should be given immediately Injury to the vena cava is not an extremely rare accident, and if properly treated the patient usually recovers It may be torn while freeing a very adherent kidney or incised when blindly dividing the renal pedicle A vein may be torn off as it enters the larger vessel, it may be injured by the tip of a forceps that is applied to the renal pedicle, or when attempting blindly to clamp a bleeding vessel The bleeding is usually quite profuse, but is controlled easily by packing The packing should be left in place until the pedicle has been ligated and preparation has been made to suture the opening When available, two small rubber covered clamps may be placed, one below and one above the injury The opening is then sutured with fine silk in a small straight needle In one case in which I

ACCIDENTS

The accidents that may occur during nephrectomy are injuries to adjoining structures and hemorrhage from the vascular pedicle. Fortunately, they are rarely serious if recognized and corrected promptly. The most frequent accident is injury to the peritoneum. The peritoneum may be mistaken for the perirenal fascia and divided while trying to expose the kidney. This injury is avoided by separating the perirenal fascia from the lumbar muscles and dividing it well behind the kidney. As the fascia is separated from the kidney it is reflected medially. The peritoneum is reflected with the fascia and protected. The peritoneum is most frequently torn while stripping it from the anterior surface of a large pyonephrotic kidney or when attempting to remove a kidney tumor through a lumbar incision. When freeing the kidney anteriorly it is important to inspect the peritoneum frequently and suture torn areas immediately to prevent infection of the peritoneal cavity. When exposure is difficult and there is probability of further injury to the peritoneum, the torn area may be protected with a moist sheet and the injured area repaired after the kidney has been removed. When the peritoneum is densely adherent over a limited area, it simplifies the operation to open the peritoneum purposely, excise the adherent area, leaving it attached to the kidney, and close the peritoneal wound. This is particularly advisable in thin-walled pyonephrotic kidneys and in malignancy, where efforts to separate densely adherent peritoneum may injure the kidney and contaminate the wound.

The pleura may be injured in attempting to increase operative space at the upper angle of the wound The pleura usually terminates at the lower margin of the eleventh rib, but occasionally it extends to or below the lower margin of the twelfth rib. Furthermore, when the twelfth rib is rudimentary, the incision may extend to the eleventh rib. The incision should be extended upward with extreme care. The pleura and even the diaphragm may be torn by forceful separation of dense adhesions, or by freeing a malignant tumor at the upper pole. Injury to the pleura is usually recognized by the sucking sound of air rushing into the pleural cavity. The injury is not usually serious if the opening is promptly closed The finger should be passed immediately beneath the rib margin and the pleura pressed against the rib until the rent can be closed with mattress sutures of No. 1 plain catgut. If the tissues are fixed by inflammatory exudate and the wound is difficult to approximate, the wound may be plugged with moist gauze while the twelfth rib is resected. This mobilizes the tissues so that the wound can be sutured without tension. If extensive collapse of the lung occurs, the patient will appear quite sick for a while, with increased respirations, rapid pulse rate, and elevation of temperature. If the wound has been accurately sutured, these symptoms can be greatly ameliorated by aspirating air from the pleural cavity. Empyema occasionally results from this accident

Hemorrhage from the renal pedicle may occur immediately (1) when a vessel is not included in the clamp, (2) when a blood vessel is torn while freeing the kidney, (3) when the pedicle slips from the forceps or ligature, or

CHAPTER XVI

ANEURYSM OF THE RENAL ARTERY

Aneurysm of the renal artery is a rare condition The cause is often obscure, but there is a history of trauma in a large percentage of cases Severe debilitating diseases such as rheumatism or endocarditis have been mentioned as possible causative factors, while general arteriosclerosis and syphilis have been present in a few cases

Fig 31 —False aneurysm of right renal artery Pyelogram showing an external mass with peripheral calcification producing pressure defects on upper pole of the kidney (Dr H H Howard's cases reported in Journal of Urology January 1941)

The pathology is similar to that of other aneurysms A true aneurysm is usually caused by some degenerative change in the arterial wall, although in some cases there is a history of trauma The walls of the sac may contain calcium plaques Aneurysms usually interfere with the renal circulation, causing degenerative changes in the kidney Occasionally they rupture, either spontaneously or because of trauma A false aneurysm follows trauma with complete rupture of the artery The blood is retained by the surrounding tissues They are much larger than true aneurysms and the walls are composed of laminated blood clots and are covered by a portion of the renal capsule

tore the vena cava the rent was sutured with 00 plain catgut and a flap of muscle was sutured over the injured area. In another case, exposure was very difficult and the wound was approximated by a curved forceps which was left on for seventy-two hours. Both patients recovered. In severe lacerations, recovery has occurred when the vessel was ligated, placing the ligature below the left renal vein.

The duodenum is in close relationship with the right renal pelvis and pedicle (Fig. 2). When this region is infiltrated with inflammatory exudate, the duodenum may be included in a ligature of the pedicle, particularly if the ligature is placed with a needle. More frequently the duodenum is crushed with forceps blindly placed in an effort to control bleeding, or occasionally forceps left on the pedicle include a segment of the duodenum. The injury is rarely recognized at the time of operation. Duodenal contents usually appear in the drainage after three or four days and are extremely irritating to the tissues If the injury is recognized during the operation, the traumatized area should be turned into the lumen of the duodenum with a single row of fine silk or linen sutures. When a duodenal fistula occurs during convalescence, an abdominal incision should be made immediately and the fistula closed. If this is impossible, a posterior gastroenterostomy should be done and the pyloric end of the stomach closed with a heavy ligature. When the patient's condition will not permit a major operation, a jejunostomy may be done under local anesthesia. Fluid and food are furnished through the jejunostomy tube and nothing is given by mouth. The patient is supported by transfusions of blood and solutions of dextrose intravenously, and the drainage is removed by continuous suction. A mortality rate of about 50 per cent is reported in such cases. The best results have been obtained when the fistula was closed. Injury to the colon is infrequent, but when the colon is adherent to a large pyonephrotic or malignant kidney, it may be torn. If the bowel is immediately sutured, recovery is usually uneventful. A fistula of the colon practically always heals. I have seen two cases of fistula of the colon that resulted from the pressure of drainage tubes. Both of them healed in about ten days.

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Fig. 254.—Aneurysm of right renal artery. Half moon shaped shadow of calcified wall of the aneurysm appears just above the renal pelvis.

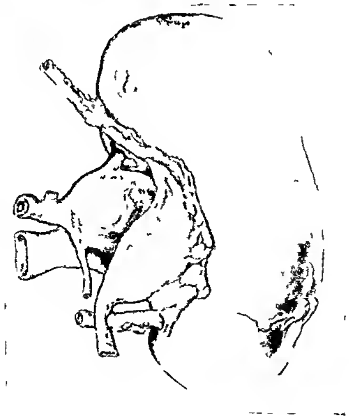

Fig. 255.—Aneurysm of the renal artery. Complaint left lumbar pain, coexisting hydronephrosis caused by aberrant blood vessel.

Fig 252 —Ring shadow of aneurysm of left artery (Dr H I Suby's case, reported by Renck, G Acta Radiologica 7 309-321, 1926)

Fig 253 —Pyelogram of left kidney, showing shadow demonstrated in Fig 252 to be outside the renal pelvis (Renck, G Acta Radiologica 7 309-321, 1926)

Fig. 54.—Aneurysm of right renal artery. Half moon shaped shadow of calcified wall of the aneurysm appears just above the renal pelvis

Fig. 55.—Aneurysm of the renal artery. Complaint left lumbar pain, coexisting hydronephrosis caused by aberrant blood vessel

or by peritoneum. In some cases they grow quite slowly but eventually rupture into the retroperitoneal space, the peritoneum or renal pelvis. The kidney is destroyed by pressure or by disturbance of the circulation.

The diagnosis of a renal aneurysm is usually difficult. It may cause no symptoms at all or the symptoms may simulate those of abdominal or renal pathology. Of three patients reported by Howard, Suby, and Harberson, one with a false aneurysm complained of a heavy feeling in the right side of her abdomen and some urinary frequency. There was a palpable mass in the right upper quadrant of her abdomen. A diagnosis of calcified solitary cyst was made (Fig 251). Operation was refused. Three months later she was again admitted to the hospital because of severe pain and shock. The aneurysm had ruptured. The second patient complained of pain in the lower part of the back and pain originating in the right flank and radiating to the lower abdomen and to the right leg. An exploratory laparotomy was done and a true aneurysm of the right renal artery was found (Figs 252 and 253). In the third patient, who entered the hospital because of retention of urine, a true aneurysm was found at necropsy. A patient admitted to my service in the hospital of the Medical College of Virginia because of renal colic had a small stone in the upper third of the right ureter and a small aneurysm of the renal artery. There was a crescent-shaped shadow just above the renal pelvis (Fig. 254) The significance of the shadow was not recognized until a necropsy was done. The patient died suddenly from a pulmonary embolus 24 hours following cystoscopic examination Howard, Forbes and Lipscomb reported a case of aneurysm of the left renal artery in a child suffering from hypertension. The aneurysm was discovered while a sympathectomy was being done. Nephrectomy relieved the hypertension

An opaque ring-shaped shadow found in the region of the kidney pelvis is suggestive of aneurysm (Figs 252, 253 and 254). This must be differentiated from gallstone or a calcified gland. A patient with a large, quiescent false aneurysm may complain of a dull ache in the lumbar region A mass is often palpable and must be differentiated from other enlargements of the kidney. Pulsation is occasionally felt. Differentiation from tumor or cyst is difficult except at operation A ruptured aneurysm causes sharp, severe pain accompanied by shock. Profuse hematuria occurs when it ruptures into the renal pelvis.

Nephrectomy is the treatment of choice (Fig. 255). Conservative operations are usually followed by secondary hemorrhage

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CHAPTER XVII

THE ADRENAL GLANDS

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In recent years great strides in the knowledge of adrenal physiology have been accompanied by increasing surgical intervention in the adrenal glands

In general the major indications for adrenal surgery are (1) hyperfunction of the adrenal cortex or medulla, (2) tumors of the adrenals, undifferentiated, cortical or medullary, hormonal or nonhormonal, and (3) normal adrenals that are to be removed because of their effect upon other, diseased conditions

Hyperfunction of the Adrenal Cortex

Hyperfunction of the adrenal cortex is responsible for two main clinical entities namely (1) the adrenogenital syndrome, and (2) Cushing's disease The former is most frequently found in female children with bilateral hyperplasia of the adrenal cortex producing an excess amount of androgenic steroids as determined by estimation of urinary 17 ketosteroids In these cases the chief signs are those of adult masculinization a false, precocious male puberty Frequently abdominal exploration with gonadal biopsy is necessary in order to accurately determine the sex of the child Diagnosis of this entity depends on physical findings and elevated urinary 17 ketosteroids Frequently presacral oxygen insufflation is of considerable aid in differentiating bilateral hyperplasia from androgenic cortical tumor The administration of cortisone to these patients should result in a lowering of the 17 ketosteroids in the urine to relatively normal levels for age and is a further diagnostic aid, inasmuch as with tumor cases there is no reduction in the steroid assay in the urine

Hormonal treatment with cortisone seems to be superior to surgical therapy in these cases at present

Cushing's syndrome is most frequently seen in adult females though it may occur in children It is characterized by muscular weakness variable hypertension osteoporosis, hirsutism glycosuria, amenorrhea in the female and impotence in the male It is most frequently caused by bilateral adrenal hypertrophy, though sometimes associated with normal sized adrenals and tumors An excess production of corticosteroids is seen as shown by an increase in urinary corticoids The urinary 17 ketosteroids may be normal or decreased

Diagnosis of Cushing's disease depends on the typical physical findings of "moon face," trunk obesity with thin extremities, abdominal striae, and the

aforementioned characteristics, plus an elevation of the urinary corticoids. Presacral oxygen insufflation has been very beneficial in differentiating adrenal hypertrophy from tumor.

Treatment of Cushing's disease due to adrenal cortical hypertrophy should consist of surgical removal of about 90-100 per cent of the adrenal tissue. This may be accomplished at one sitting, utilizing the modified Young operation for bilateral adrenal exposure. We have preferred to remove about 90 per cent of one adrenal at one operation and to perform a complete adrenalectomy on the contralateral side about ten to fourteen days later. No hormonal supportive measures are needed at the first operation However, at the time of the second operation, or if bilateral simultaneous exposure is performed, definite pre- and postoperative hormonal therapy is indicated In general this consists of 200 mg. of cortisone given intramuscularly for two days preoperatively and for several days thereafter, the length and time depending on the clinical condition and electrolyte and carbohydrate state The dose is then gradually tapered down A maintenance dose of 12.5 to 50 mg may be needed to maintain these patients. DCA is given on the day of operation and the first postoperative day, and is continued thereafter only if needed as judged from the serum sodium. Radiation of the pituitary has been used rather widely in treatment of this condition, with variable results.

Tumors of the Adrenal Cortex

Tumors of the adrenal cortex are either nonhormonal or hormonal in character, with the latter group being androgenic, estrogenic, corticoid, or mixed in type

Nonhormonal tumors are relatively infrequent and rarely cause symptoms until they have reached considerable size, the usual symptoms being those of flank mass or pain. The diagnosis is usually made by pyelography which reveals displacement of the kidney downward. Presacral oxygen insufflation is frequently of considerable aid in demonstrating the mass, and occasionally translumbar aortography is of value in differentiating the mass from large upper pole renal cysts or tumors.

These tumors are radioresistant and are best treated by surgical excision We have found the dorsolumbar flap incision to be very satisfactory in handling large adrenal or upper pole renal masses, though many urologists prefer the thoracoabdominal or transverse abdominal transperitoneal approach for these cases. No specific pre- or postoperative preparation is needed when dealing with these tumors.

Androgenic tumors of the adrenal cortex occur most commonly in young, female children The changes which occur are similar to those associated with bilateral adrenal hypertrophy. As a rule the child is normal at first, with a following change toward adult masculinity An increase in urinary 17-ketosteroids is always present in these cases It has been shown that the administration of cortisone to a patient with an androgenic tumor will produce no

change in the 17 ketosterol determination, while such therapy will reduce the 17 ketosteroids in the urine significantly when administered to the patient with bilateral adrenal hypertrophy

Localization of the tumor is usually facilitated by presacral oxygen insufflation combined with intravenous urography

Surgical excision of these tumors usually produces a cure with complete reversal of symptoms No specific hormonal therapy is needed, and these cases tolerate trauma and stress well The tumors may be removed through a dorsolumbar flap, thoracoabdominal or transverse abdominal transperitoneal approach

Corticoid tumors produce a picture similar to that seen in the adrenocorticoid syndrome caused by bilateral adrenal hypertrophy They are not frequently seen in adult females The 17 ketosteroids may be normal or depressed The urinary corticoids are usually elevated As a rule the differential diagnosis between tumor and bilateral hypertrophy can be made by means of presacral oxygen insufflation though occasionally, because of anatomic conditions a definite preoperative differentiation cannot be made In these cases bilateral simultaneous adrenal exposure is indicated

When tumor is present, the opposite adrenal is almost invariably atrophic and ACTH must be given postoperatively to stimulate its function These patients in general are guarded risks and careful substitution therapy as previously outlined is needed before during, and after surgery In the immediate postoperative period infusions of whole blood and norepinephrine should be employed if the blood pressure falls Serum sodium and potassium levels should be carefully followed and these electrolytes replaced as needed

The dorsolumbar flap incision is very satisfactory for exposure of a localized tumor However, if accurate localization is impossible or possibility of bilateral hypertrophy exists, we prefer the modified Young's approach for bilateral simultaneous adrenal exposure

Estrogenic tumors are quite rare, having been most often seen in adult males They are characterized by increase in female characteristics with decrease in size of genitalia impotence and loss of libido increase in size of breasts and nipple, and loss of body hair

The diagnosis is usually made on the basis of physical changes and findings of large amounts of excess estrogens in the urine Localization of the tumor may frequently be accomplished with oxygen insufflation x rays

These tumors are usually carcinomatous and treatment consists of complete surgical removal, utilizing any of the previously mentioned approaches No specific hormonal management is needed in these cases

Mixed tumors of the adrenal cortex are usually carcinomatous and are most frequently seen in females It has been estimated that they constitute about 25 per cent of the adrenal cortical tumors in children These patients generally present the appearance typical of Cushing's syndrome together with masculinizing virilism The urinary 17 ketosteroids and corticoids are elevated

Diagnosis depends on physical changes, urinary hormonal studies, and localization of tumor by means of intravenous pyelography combined with presacral oxygen insufflation.

Treatment consists of early operative removal, together with careful hormonal management, as for those patients with corticoid adrenal tumors

Recurrence of symptoms is fairly frequent because of metastasis to the lungs and/or liver. The administration of cortisone to these patients has proved to be of no value.

Tumors of the Adrenal Medulla

Tumors of the adrenal medulla may be classified as hormonal or nonhormonal. The former arise from the pheochrome cells, while the latter have their origin in the ganglia cells of the medulla.

Nonhormonal tumors consist of the sympathicoblastomas and neurocytomas.

Sympathicoblastomas most commonly are seen in infants and children, and may occur in either adrenal or any other sympathetic ganglia They are very malignant and metastasize readily to the skull, thorax, and liver

The diagnosis is most frequently made, as with Wilms' tumors, by discovery of an abdominal or flank mass. As a rule they are without symptoms unless advanced metastasis has occurred. Intravenous pyelograms will usually reveal a mass above one kidney with downward displacement of the latter.

Treatment consists of early operative removal of the tumor, with avoidance of excessive trauma Either the transverse abdominal transperitoneal or the dorsolumbar flap approach is satisfactory, and every effort should be made to ligate all vessels to and from the tumor prior to handling Postoperative irradiation is probably of some value, particularly if obvious tumor extension or metastasis is present.

The neurocytomas are usually seen in adults and as a rule are accidentally discovered as a flank or abdominal mass They are generally benign or of very low malignancy, and complete surgical removal should produce a cure Excretory or retrograde pyelograms, oxygen insufflation x-rays and lumbar aortograms are helpful in differentiating these tumors from those of renal origin. Treatment consists of surgical excision, utilizing any one of the conventional approaches

In recent years considerable attention has been focused on the diagnosis and treatment of pheochromocytomas These tumors are most commonly found in the adrenal medulla, though they also occur in the retroperitoneal ganglia. About 90 per cent of these tumors are benign. They have been shown to produce epinephrine and norepinephrine in varying amounts, and it is felt that the symptoms produced are the result of an excess of varying amounts of these two substances

About one-third of the cases of proved tumors exhibit paroxysmal episodes of hypertension, while persistent hypertension with or without par-

oxysmal crises is more frequently the presenting symptom. Other findings include hypermetabolism, glycosuria and elevated blood sugar, headache, rapid pulse, weakness and marked sweating.

The diagnosis of pheochromocytoma depends on the above findings, pharmacological tests, and radiography.

The most widely used pharmacological studies are the histamine, benzodioxane and Regitine tests. In the former, intravenous injection in a patient with a tumor will produce a marked rise in blood pressure associated with symptoms of precordial and abdominal pain, headache, nausea, and sweating. The duration of the crisis is usually short, with the blood pressure returning to near its former level. This test is generally quite reliable, though negative results in proved tumor cases have been reported.

Benzodioxane and Regitine, when administered intravenously in the presence of sustained hypertension or during a paroxysmal attack, will produce a significant fall in blood pressure in those patients with pheochromocytoma.

Accurate localization of the tumor preoperatively is frequently possible with presacral oxygen insufflation combined with intravenous pyelography. This is particularly true of those tumors located in the adrenal gland. When the tumor is situated without the adrenal it is frequently difficult to outline it with gas. We have localized four pheochromocytomas in the past year with retroperitoneal oxygen insufflation, and have had one known failure. This latter was a tumor located in the right adrenal in a seven year old male. Air studies in this child were interpreted as being within normal limits. A chest x-ray should always be made because of the possibility of an intrathoracic tumor.

Treatment of these tumors consists of surgical removal, and such removal will completely relieve the patient of the signs and symptoms of the suprarenal sympathetic syndrome. Careful planning of the procedure is quite necessary to ensure a successful result. We have preferred nitrous oxide, oxygen, and ether for anesthesia. Regitine may be given intravenously preoperatively in those cases with sustained hypertension, and should be available for immediate use to combat any rise in the blood pressure which may occur during the handling of the tumor. Likewise, norepinephrine (4 mg/liter) must be available for immediate use, to control the hypotension and circulatory collapse which frequently follow removal of the tumor. It is given intravenously at a rate sufficient to maintain a moderate hypertension.

Surgically the tumor may be removed through any of the conventional approaches to the adrenal. We have routinely employed the dorsal flap approach of Nagamatsu when the tumor could be localized preoperatively. However many authors feel that the transverse upper abdominal transperitoneal approach is preferable because of the possibility of multiple tumors and because of the variability of their location. An adequate exposure is essential and whenever possible the blood supply to and from the tumor should be occluded before any manipulation occurs.

SURGICAL TECHNIQUE

As previously mentioned, the adrenal glands may be approached through a variety of incisions, and each has its own merits We have utilized the dorsolumbar flap incision (page 148) for all cases of adrenal tumor in which the pathology was accurately localized preoperatively. The transabdominal approach (page 150) is of greatest benefit in those cases in which both adrenals must be exposed and additional abdominal or retroperitoneal exploration is desirable This is particularly true in cases of suspected pheochromocytoma in which adequate preoperative localization is not obtained. For those cases of suspected bilateral disease, the posterior approach of Young allows bilateral simultaneous exposure of the adrenals.

The patient is placed prone and flexed at the trunk, with the thighs lowered about 20 degrees The incision is made directly over the eleventh or twelfth rib, following the curve of the rib downward and laterally. The rib is exposed, and resected subperiosteally. The subcostal muscles are incised transversely to expose the lumbodorsal fascia. This is opened, with care being taken not to injure the pleura at the costovertebral angle. An excellent

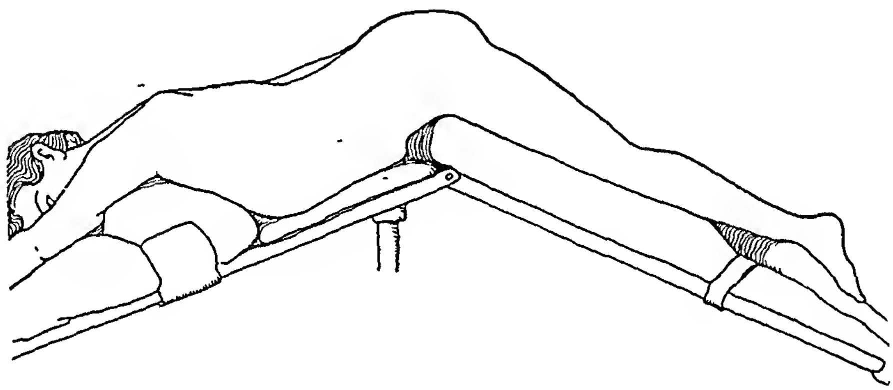

Fig 256—Position of patient upon the table for simultaneous exposure of the adrenal glands

view is afforded of the structures beneath The retroperitoneal fat is stripped off, exposing Gerota's fascia This fascia is stripped away from the quadratus lumborum muscle and divided near the upper pole of the kidney, exposing the kidney below and the adrenal gland above. The adrenals are held in close apposition to the upper poles of the kidneys by the dorsal veins which come off from the renal pedicle. By downward and outward traction on the upper pole of the kidney and with the assistance of clamps on the fascia, the gland is drawn toward the surface of the wound (Fig. 258). The gland may now be stripped free of fat and adhesions and carefully examined for the presence of pathologic conditions It is Young's opinion that even though a lesion exists in one adrenal, it is wise in most instances to expose the opposite adrenal before carrying out any operative procedure upon the gland. The left adrenal may be exposed by an assistant while the operator is exposing the right. Both adrenals having been satisfactorily exposed, a retractor especially designed for this work is introduced. By a double-acting screw the retractor blades which slide upon lateral bars are made to compress the spinal muscles on each side, considerably enlarging the wound. The

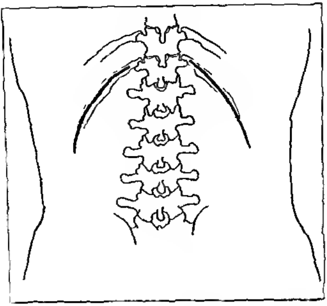

Fig 257—Incisions for simultaneous exposure of both adrenals

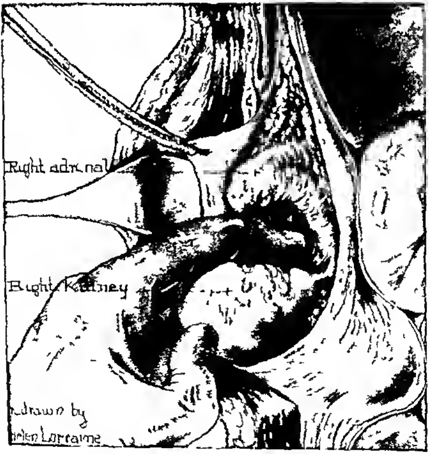

Fig 258—The adrenal gland is being brought into view by traction on the upper pole of the kidney

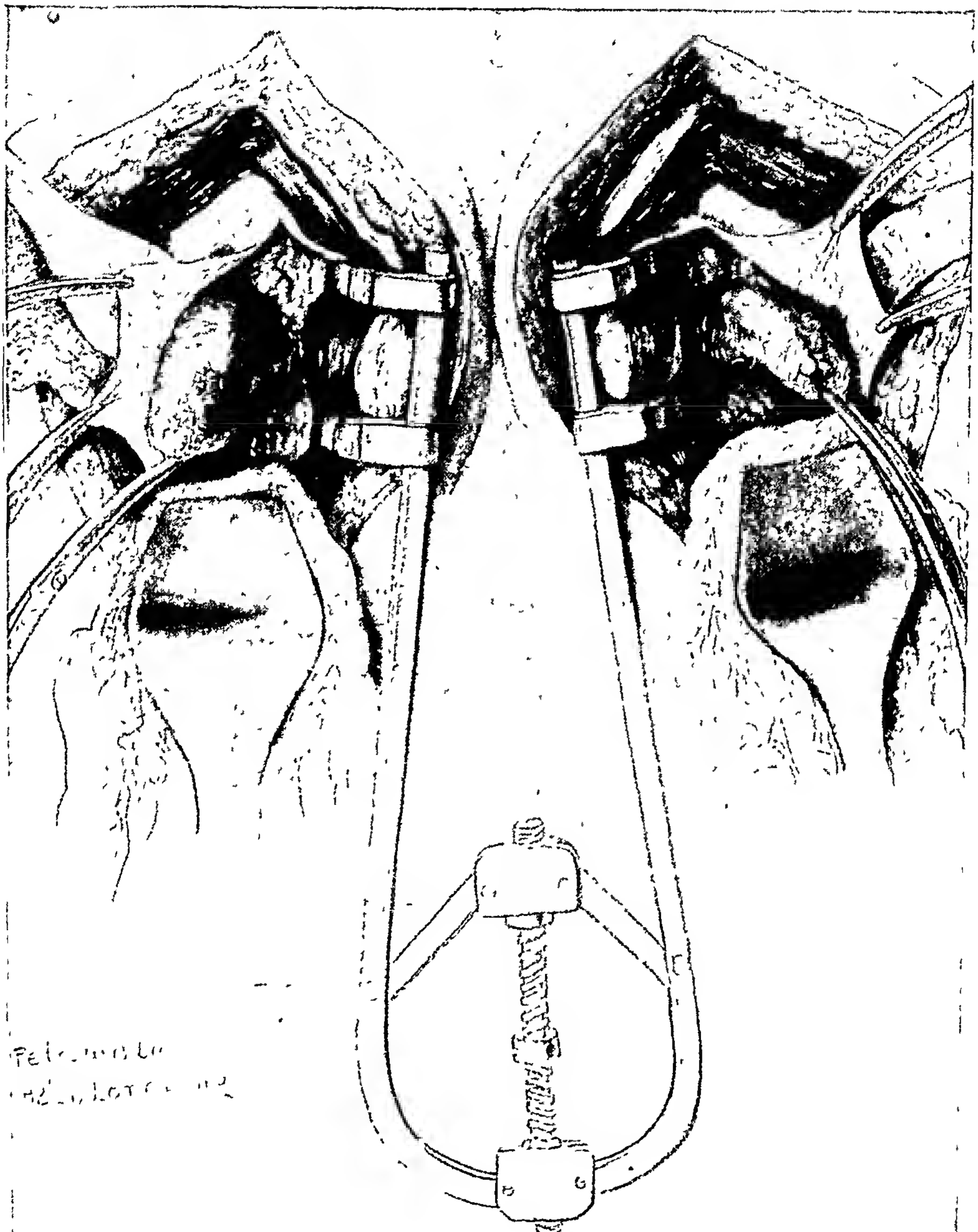

Fig. 259 —Bilateral exposure of the adrenal glands for comparison and operation The exposure is greatly improved by the use of Young's retractor.

adrenal glands are then compared and further operative procedure is decided upon (Fig 259) Small tumors may be shelled out, an entire gland or a portion of both glands removed, or the glands may be denervated When the operation is completed, all bleeding points are ligated, a small cigarette drain is placed in the wound to emerge at the upper angle, and the wound is closed in layers

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CHAPTER XVIII

SURGICAL APPROACH TO THE URETERS INCISIONS FOR OPERATIONS ON URETERS

Anatomy, Lumbar Incisions, Anterior Abdominal Incisions, Vaginal Incision

SURGICAL APPROACH TO URETERS

The ureter is approached surgically through the abdominal muscles and their aponeuroses and fascial coverings. The posterior portion of the external and internal oblique muscles and the aponeurosis of the transversalis muscle have been described in discussing the surgical approach to the kidney. These structures cover the lateral abdominal wall, and it is through them that incisions are made to expose the upper third of the ureter.

The intermediate and anterior fibers of the external oblique muscle arise from the ribs forming the costal arch and pass downward and inward The intermediate fibers form the inguinal (Poupart's) ligament. The anterior fibers become aponeurotic near the linea semilunaris and below the anterior superior spine of the ilium pass inward and downward to cross the anterior surface of the rectus abdominis muscle to be inserted into the xiphoid, linea alba and pubic symphysis.

The internal oblique muscle lies immediately beneath the external oblique. It arises from the lumbodorsal fascia, the anterior two-thirds of the iliac crest and the lateral half of the inguinal ligament. The posterior fibers are included in the iliocostal area and are inserted into the lower ribs and their cartilages. The fibers included in the anterior abdominal wall form an aponeurosis before reaching the semilunar line Above the semicircular line, which is situated midway between the umbilicus and symphysis pubis, the aponeurosis divides into two lamellae. The anterior lamella joins the aponeurosis of the external oblique to form the anterior sheath of the rectus muscle, the posterior lamella fuses with the aponeurosis of the transversus abdominis to form the posterior rectus sheath. Below the semicircular line the aponeuroses of external oblique, internal oblique and transversus abdominis muscles pass in front of the rectus muscle. The anterior fibers of the internal oblique pass straight across the abdomen, those crossing the upper abdomen take a slightly upward course, and those arising from the inguinal ligament go slightly downward. The lowermost fibers blend with corresponding fibers of the transversus abdominis to form the conjoined tendon and become attached to the pubic crest.

The transversus abdominis muscle lies beneath the internal oblique. It arises from the lumbodorsal fascia as an aponeurosis (the transversalis fascia), the iliac crest, the lateral third of the inguinal ligament and from the inner aspects of the lower six costal cartilages. Its fibers pass directly across the

abdomen Its aponeurosis passes behind the rectus abdominis muscle above the semicircular line and anterior to this muscle below the semicircular line

The transversalis fascia lies beneath the muscle and lines the abdominal cavity It is separated from the peritoneum by loose areolar tissue Below the semicircular line it is the only fascial covering of the posterior surface of the rectus abdominis muscle

The rectus abdominis muscle is composed of thick flat bands that lie on each side of the linea alba or midline of the abdomen Each muscle arises from the anterior surface of the fifth, sixth and seventh costal cartilage and from the xiphoid process and is inserted into the pubis between the crest and the symphysis The muscle fibers are interrupted by three to five tendinous intersections the lineae transversae, which cross the muscle and are adherent to its anterior sheath The anterior sheath of the rectus muscle above the semicircular line is formed by the aponeurosis of the external oblique and the anterior lamella of the internal oblique Below the semicircular line it is composed of the aponeuroses of all three transverse muscles of the abdomen The posterior sheath, composed of the aponeurosis of the transversus abdominis and a portion of the aponeurosis of the internal oblique, terminates in a free crescentic margin, the semicircular line (semicircular fold of Douglas) midway between the umbilicus and the pubis From here down transversalis fascia is the sole posterior covering of the rectus The linea semilunaris is formed by the coalescence of the aponeuroses of the transverse abdominal muscles as they approach the margin of the rectus muscle The linea semilunaris is represented on the surface by a depression which runs parallel with the external margin of the rectus muscle

Blood Vessels

The blood supply of the anterior abdominal wall is derived from the last six intercostal and the four lumbar arteries, and the superior and inferior epigastric and the deep circumflex iliac arteries These vessels anastomose freely and any of them may be divided and ligated without disturbing the nutrition of the tissues The intercostal and the lumbar arteries accompany the intercostal, iliohypogastric, and ilioinguinal nerves between the transversus abdominis and internal oblique muscles When it is necessary to divide these vessels, the nerve should be avoided if possible and especially should not be included in the ligature The inferior epigastric artery arises from the external iliac and passes upward and inward, piercing the transversalis fascia to enter the rectus sheath after passing in front of the semicircular line It is often necessary to divide this artery when exposing the lower end of the ureter A branch of the deep circumflex iliac artery is frequently cut in muscle splitting incisions which extend above the anterior superior spine of the ilium

Nerves

The anterior branches of the lower six intercostal nerves pass downward and forward across the anterior abdominal wall They run between the transversalis and internal oblique muscles After giving off branches to supply the

transverse muscles and the overlying skin, their terminals supply the rectus muscle, pierce the rectus sheath and end in the subcutaneous tissue and skin. Oblique incisions for exposing the ureter should pass below these nerves. Division of their terminal branches is the chief objection to incisions through the semilunar line.

The ilio-inguinal and iliohypogastric nerves pass beneath the internal oblique just mesial to the anterior superior spine of the ilium and are distributed mainly to the inguinal abdominal region.

The course of these nerves varies slightly in different subjects. They are occasionally encountered when exposing the lower ureter by an oblique incision. Care should be taken to avoid including them in sutures or ligatures.

INCISIONS FOR EXPOSING THE URETER

The Upper Third.—The upper third of the ureter may be approached by an incision like that of the anterior half of the usual curved incision for exposure of the kidney. The patient is placed on his side with the loin elevated

Fig 260.—Incision for exposing the upper third of the ureter.

as in operations upon the kidney. The incision begins at the midaxillary line about halfway between the last rib and the crest of the ilium, and extends forward and downward to a point about an inch in front of the anterior superior spine of the ilium (Fig. 260). This incision lies between the twelfth intercostal nerve above and the ilio-inguinal and iliohypogastric nerves below, and avoids injury to them The fibers of the external and internal oblique muscles are divided (Fig. 261), and all bleeding areas are clamped and ligated or sutured

The further steps of the operation are much more satisfactory if a dry wound is secured before exposing the retroperitoneal area. An incision is then made through the transversalis muscle and fascia. It is divided or torn open in the direction of its fibers, and the retroperitoneal fat is exposed. In thin patients, especially those with poor muscular development, adequate exposure can be obtained by splitting all three muscles in the direction of their fibers. When practical, this is preferable to dividing the muscles. At, or just above, the posterior angle of the wound, the lower pole of the kidney can be palpated. The peritoneum is retracted medially and the ureter is exposed by separating the loose areolar tissue in the depth of the wound by blunt dissection. Frequently the spermatic or ovarian vessels are recognized first and may be seen to cross over the ureter near the lower angle of the wound (Fig 262). They should be carefully pushed aside and preserved. If the operation is for the removal of a stone, it can be recognized usually by an area of swelling in the ureter, and if the stone has been impacted for several days there is increased vascularity of the area, with the periureteral fat often matted together and adherent to the ureter. This should be carefully dissected away before the ureter is opened. It is a good precaution to place a piece of narrow tape or heavy plain catgut around the ureter above the stone as early as possible to prevent the stone from slipping upward during the manipulation and to hold the ureter in place for incision and removal of the stone.

When a stone is impacted at the ureteropelvic juncture, it is more easily approached if the posterior angle of the incision is extended upward and backward toward the costal margin for about two inches. The anterior fibers of the latissimus dorsi may be divided or retracted upward and the incision in the lumbar fascia extended upward. The perirenal fascia is then opened posteriorly and retracted forward with the peritoneum. The lower pole of the kidney is retracted upward and forward and the ureteropelvic area is exposed. It is unnecessary to expose the entire kidney to remove a stone impacted in the pelvic orifice. If the stone should slip back into the pelvis, the lumbar incision may be completed and the kidney exposed. Adhesions to the lower pole of the kidney are quite dense in some cases. Bands of tissue should be examined carefully before they are divided. The ureter, when thin and retracted out of its normal course, may be mistaken for a band of adhesions, or an aberrant blood vessel to the lower pole of the kidney may be divided before it is recognized. This incision for exposing the upper ureter is adequate for removing stones or foreign bodies from the upper third of the ureter, for excision of the nerve supply to the upper ureter, or for ureterotomy for drainage. Occasionally in cases of pyonephrosis when the patients are very ill, the simplest and safest method of draining the kidney is to insert a soft catheter through a ureterotomy wound into the renal pelvis. This is also a logical method of temporary drainage when the ureter has been accidentally ligated at operation. Gordon S Foulds drained the ureter with a small T tube in cases of chronic obstruction because of stricture or stone, and in cases of acute renal infection with obstruction when ureteral catheters are not tolerated or are inadequate.

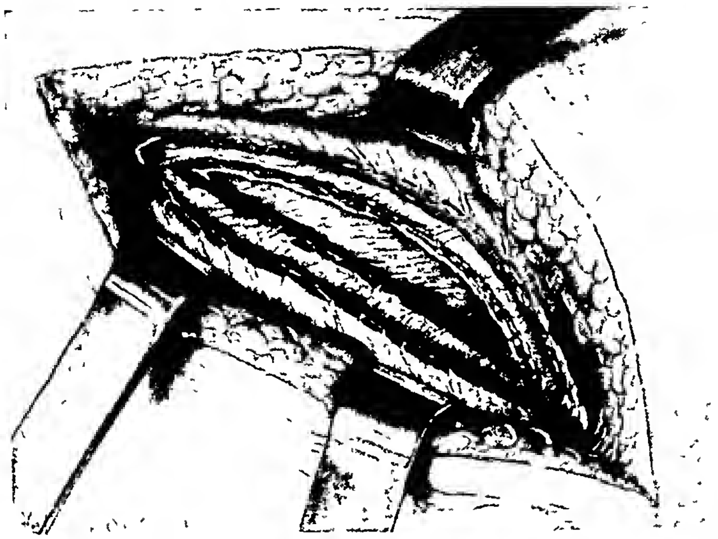

Fig. 261.—The tissues have been divided through the internal oblique muscle, exposing the transversalis muscle

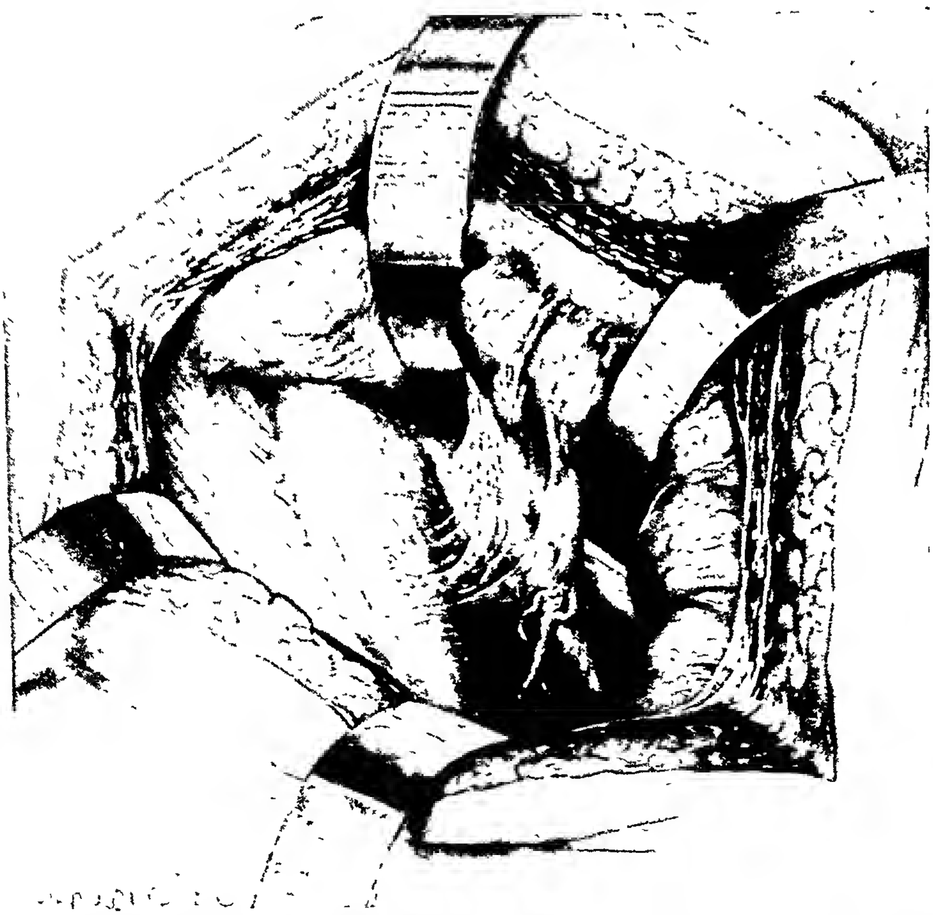

Fig 262.—The parietal peritoneum is liberated and retracted toward the midline, exposing the ureter as it lies near the inner margin of the psoas muscle. In this area the ureter is not adherent to the parietal peritoneum Note spermatic vessels crossing the ureter near the lower angle of the wound.

When plastic operations are necessary upon the upper ureter or uretero pelvic area, it is better to expose the entire kidney. In most cases nephropexy or nephrostomy is a necessary part of the operation. In thin patients with considerable space between the crest of the ilium and the costal margin, the upper ureter and pelvic area may be exposed through a straight lumbar incision extending from the crest of the ilium upward along the margin of the sacrospinalis muscle. This incision passes through the three layers of the lumbodorsal fascia just before they merge to form the lumbar fascia or aponeurosis of the internal oblique. No muscles are cut and the incision furnishes a direct and easy approach to the kidney and the ureteropelvic area (Fig 92). After reaching the perirenal fascia, the operation proceeds as previously described.

Closure of the Wound.—When the operation upon the ureter is completed, the abdominal wound should be closed in layers, approximating the different structures accurately. Drainage tubes or tissue drains should be brought directly to the surface so that the drainage tract will be as short as possible. This prevents excessive absorption of infectious material and facilitates reopening the drainage tract when necessary. When the wound has been made across the posterior fibers of the abdominal muscles, the transversalis, which is split in the direction of its fibers, may be repaired by a continuous suture of No 1 chromic catgut. This suture should be interrupted at the point at which the drainage material emerges. The fibers of the internal and external oblique muscles are united with interrupted mattress sutures of the same material. Ample space is allowed for drainage, and care should be taken in placing the sutures to avoid including nerve fibers in the sutures. When there is considerable fat between the muscle and the skin, it is well to approximate the fat with interrupted sutures of No 1 plain catgut to eliminate dead space. The skin may be closed with a continuous running suture, or with a continuous mattress suture of coarse silk. Deep interrupted sutures are not necessary here and often produce stitch abscesses. If the straight lumbar incision has been used, the layers of the lumbar fascia should be accurately approximated with continuous sutures of No 1 chromic catgut. If the patient's loin has been elevated during the operation, the elevator should be lowered before the wound is sutured to facilitate accurate approximation. Drainage tubes that are not sutured to the skin should have safety pins passed through their projecting ends so they cannot be lost in the wound.

The upper third of the ureter is also readily approached by an incision described by F E B Foley. "With the patient securely fixed in the kidney position the elevator is raised only enough to widen the space between the rib and the ilium without putting the flank muscle under tension." The incision is placed on a line extending obliquely downward and forward from the middle of the twelfth rib toward the anterior superior spine of the ilium (Fig 263). The length of the incision, from four to six inches depends upon the physique of the patient and the length of ureter to be exposed. The level of the incision is made appropriate to the level of the stone to be removed or the portion of the ureter to be exposed. When the skin and subcutaneous

fascia are divided, the posterior edges of the external and internal oblique muscles and the anterior edge of the latissimus dorsi muscles are exposed (Fig. 263). The undersurfaces of these muscles are immobilized by bluntly separating them from the underlying lumbodorsal fascia. This permits the oblique muscles to be retracted downward and the latissimus to be retracted upward, thereby exposing a wide area of the lumbodorsal fascia. The lumbodorsal fascia is now split in the direction of its fibers, exposing the posterior layer of the perirenal fascia (Fig. 264). The perirenal fascia is not opened but is gently separated by blunt dissection from the muscles behind it. The dissection is continued medial to the vertebral bodies and upward or downward as indicated by the portion of the ureter to be exposed. With the perirenal fascia and contained fat retracted medially by a Deaver retractor the ureter can be seen as a ribbon-like streak running longitudinally 3 or 4 centimeters lateral to the vertebral bodies and immediately underneath the

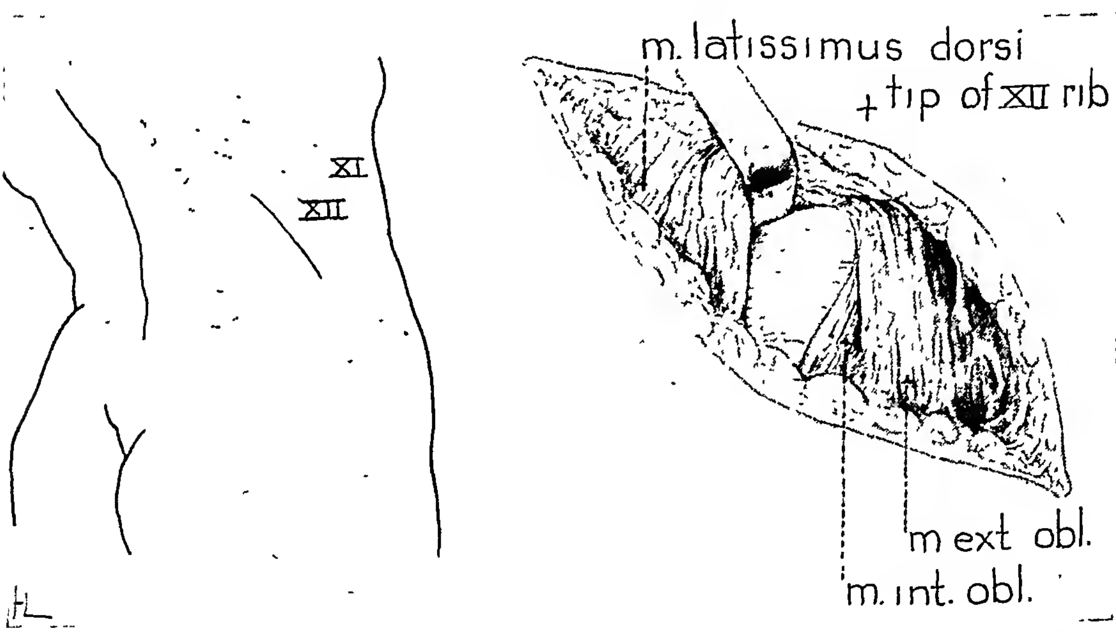

Fig 263—The Foley approach to the ureter The location of the incision may vary slightly according to the location of the stone The muscles are divided in the direction of their fibers

fascia (Fig 265). If a stone is present it usually can be identified by a bulge in the course of the ureter or can be felt with the finger. The ureter thus exposed can be dealt with according to indications. In the case of a stone, Foley recommends that the fascia and ureter be incised directly over the stone, the stone removed and the ureter closed with a continuous suture of fine catgut without exploring the ureter and that the wound be closed without drainage. This, in my opinion, should depend upon the nature of the case. If the ureter is greatly dilated above the stone or if there is infection, such practice would be unwise. A ureter greatly thickened by an impacted stone does not always heal primarily even though securely sutured. When the ureter is dilated above the stone, it is a good precaution to free it sufficiently to grasp it with a Babcock clamp or encircle it with a piece of tape before disturbing the stone.

The Middle Third —The middle third of the ureter includes the lower part of the abdominal segment and the upper part of the pelvic segment, and presents a constriction as it crosses the iliac vessels It extends approximately from the upper border of the fifth lumbar vertebra to the lower border of the

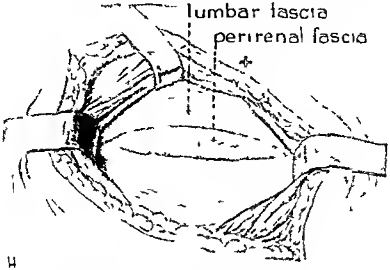

Fig 264 —The Foley approach to the ureter The muscles are retracted and the lumbar fascia is divided exposing the perirenal fascia

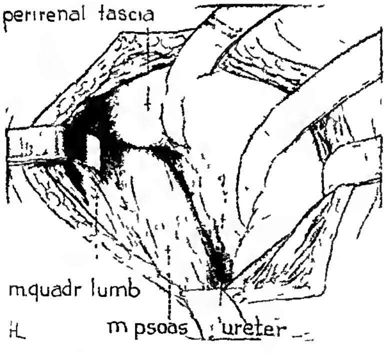

Fig 265 —The Foley approach to the ureter The fascia is stripped from the quadratus and psoas muscles The ureter is recognized in the depth of the wound covered by fascia

sacroiliac synchondrosis Diseases of the ureter other than impacted stones are unusual in this area This portion of the ureter may be exposed by an incision beginning about an inch above and an inch internal to the anterior

superior spine of the ilium and extending downward along the course of the fibers of the external oblique to the semilunar line (Fig. 266). This is similar to the McBurney incision except that it is longer. The internal oblique and transversalis muscles are divided in the direction of their fibers and as near as possible to the area of the ureter to be exposed (Fig. 267). After retracting

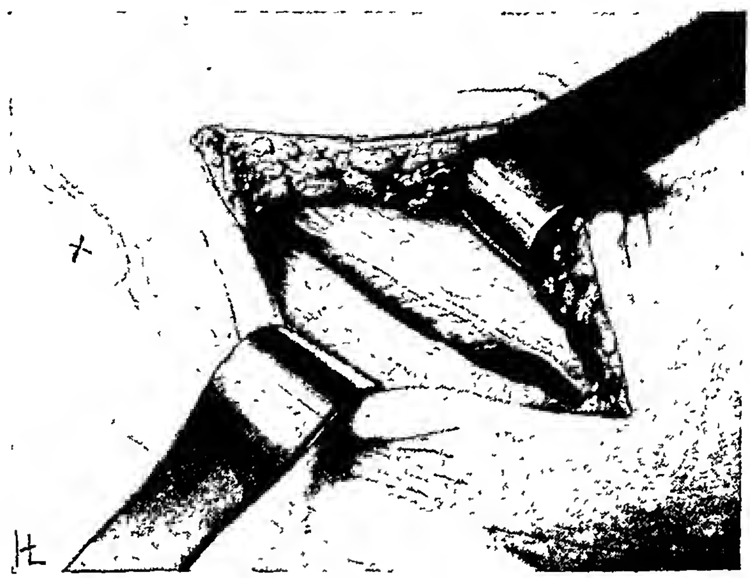

Fig 266—Incision for exposure of middle third of the ureter. "X" indicates anterior superior spine of the ilium

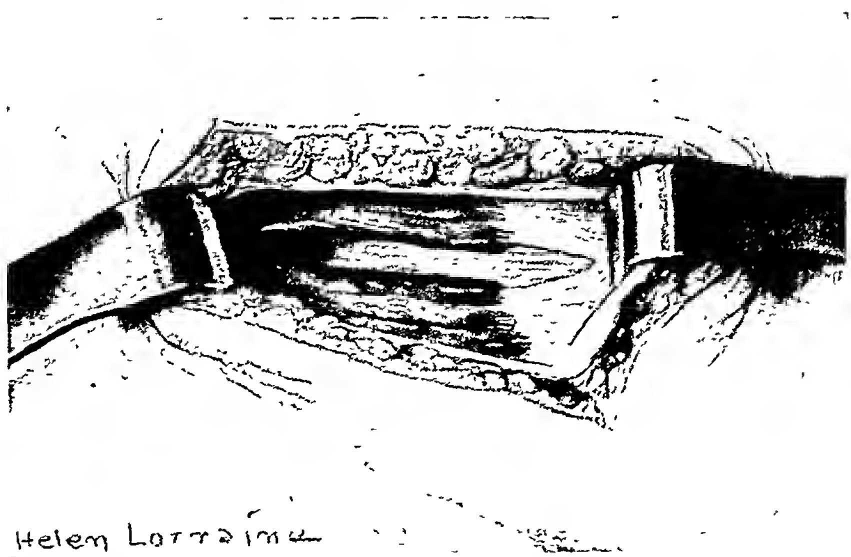

Fig 267—Aponeurosis of external oblique retracted, exposing internal oblique which has been divided in the direction of its fibers Transversalis muscle in the depth of the wound

these muscles if more room is needed the combined aponeuroses may be divided downward along the semilunar line for about an inch. This adds greatly to the exposure and does not weaken the abdominal wall if the aponeuroses are carefully sutured when the wound is closed.

The transversalis fascia is very thin and is usually divided with the muscle. The peritoneum is loosely attached to the transversalis fascia and to the lateral abdominal and pelvic walls by loose areolar tissue. This is easily separated by blunt dissection, preferably using the finger. As the peritoneum is detached, it is gently retracted toward the midline of the body by broad retractors. It is well to remember that the ureter lies near the inner margin of the quadratus lumborum muscle on a line with the tips of the transverse processes of the vertebrae in this area. The ureter is to the inner side of the spermatic or ovarian vessels and is so intimately attached to the peritoneum that it is elevated with the peritoneum when the latter is separated and retracted from the pos

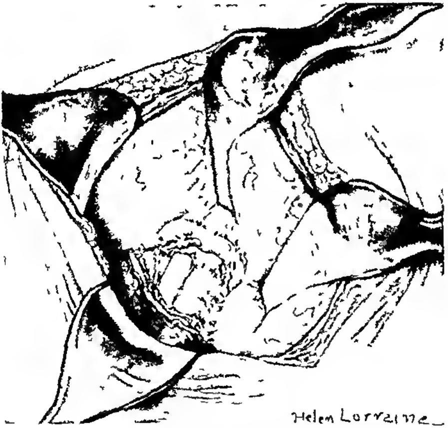

Fig. 268.—The peritoneum retracted exposing the ureter as it crosses the iliac vessels. The ureter is adherent to the parietal peritoneum in this area.

terior abdominal wall (Fig. 268). With the peritoneum separated to the bodies of the vertebrae and retracted medially, the ureter appears as a thickened band running along its posterior surface in the depth of the wound (Fig. 268). When the ureter is difficult to expose, it often can be located by turning the palms of the fingers anteriorly and palpating the posterior surface of the peritoneum. If the operation is for removal of a stone, the stone usually can be felt before the ureter is recognized. When the stone is located, it is grasped with the thumb and finger and held until the area is exposed. A loose clamp or a loop of catgut is placed around the ureter above the stone to prevent its slip

ping out of reach. A catheter passed up the ureter prior to operation is very helpful in identifying the ureter, especially in corpulent patients. The ureter is more easily located as it passes over the iliac vessels. By placing a small tape or a loop of catgut around it and making sufficient traction to make the ureter taut it can be easily traced in either direction. Occasionally periureteral adhesions, resulting from impacted calculi or chronic ureteritis, bind the ureter to the posterior abdominal wall and to the peritoneum and prevent ready retraction of the peritoneum. It is well to free such adhesions when possible to improve the mobiltiy of the ureter. There is some risk in freeing a ureter adherent to the iliac vessels. Cases have been reported in which the iliac vein was injured.

Ureterotomy, suture of ureteral wounds, and drainage following ureterotomy are discussed in Chapter XXI. It is important to remember that drainage tubes should never be placed near the iliac vessels because of the danger of erosion and hemorrhage. Only soft rubber tissue or cigarette drains should be used in this area, and they should be removed as soon as their purpose is served.

Closure of the Wound.—In this incision no muscles have been cut. The divided fibers of the transversalis and internal oblique should be sutured with No. 1 plain catgut placed just tightly enough to approximate the muscles. The aponeurosis of the external oblique is closed with a continuous suture of No. 1 chromic catgut. If the aponeuroses have been divided downward for better exposure, they should be accurately approximated with interrupted sutures of No. 0 chromic catgut. The skin is sutured as previously described. It is my practice to interrupt all lines of continuous sutures at the point of exit of drainage tubes, and to begin with a separate suture on the other side of the tube.

The Lower Third.—The lower third or the pelvic portion of the ureter extends from the lower margin of the sacroiliac synchondrosis to the bladder. In this area the ureter follows the contour of the pelvic wall, reaching its greatest outward curvature opposite the ischial spine. From this point it courses medially and downward. Throughout its pelvic course the ureter remains attached to the peritoneum and is looked for at operation on the posterior surface of this structure as it is reflected medially. This is the most difficult portion of the ureter to approach surgically because of the depth at which it lies, and it is also the area most frequently requiring surgical treatment. It is here that the ureter is usually injured during gynecological operations and that stones most frequently become impacted.

The lower third of the ureter is usually exposed either by a muscle-splitting incision similar to the one described for the middle third though placed at a lower level, or by a paramedian incision through the rectus muscle. Incisions along the semilunar line or through the lateral margin of the rectus sheath destroy nerve terminals to the rectus muscle and the adjacent area and are undesirable. In women stones impacted near the lower end of the ureter may be removed by an incision through the vaginal wall.

Operative Procedure.—The patient should be in the supine position with the table lowered a few inches at the head The Gibson incision, which I have used satisfactorily in this area, begins near the median line of the abdomen just

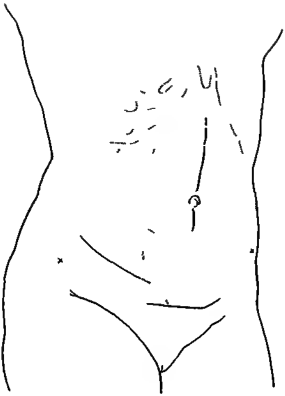

Fig. 269.—Gibson incision for exposure of the lower third of the ureter

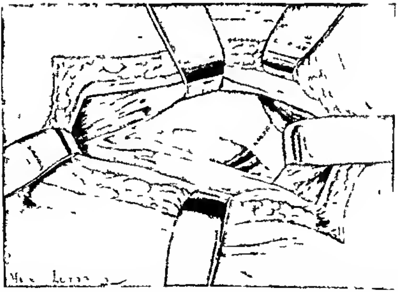

Fig. [illegible]0.—The lateral abdominal muscles have been divided in the direction of their fibers. Much additional room is provided by dividing the anterior sheath of the rectus muscle downward to the pubis. Near the lower angle of the wound the deep epigastric vessels cross beneath the transversalis fascia. They may be cut when necessary to obtain better exposure.

above the symphysis pubis and curves outward and slightly upward to a point about an inch internal to the anterior superior spine of the ilium (Fig. 269). The external oblique aponeurosis is divided in the direction of its fibers. An incision is then made in the fused aponeuroses of the internal oblique and transversalis muscles as they join to form the anterior sheath of the rectus, and these muscles are divided in the direction of their fibers. The transversalis fascia is divided (Fig. 270) and the peritoneum separated from the abdominal wall by blunt dissection, as previously described, and retracted medially. The ureter will be found in the depth of the wound attached to the posterior surface of the peritoneum. In the case of impacted stones periureteral adhesions sometimes bind the ureter and the peritoneum to the abdominal wall. In such cases it is better first to free the ureter above and below the inflammatory area. Loops of tape or catgut are placed around the ureter above and below the inflammatory mass and by gentle traction the ureter can be more easily identified and liberated. When the ureter is bound down by adhesions, the peritoneum may be torn in attempting to separate them. When this occurs, the peritoneum should be closed before the ureter is opened.

When the stone is near the bladder, more room is provided by dividing the anterior sheath of the rectus downward to the pubis. Better exposure is obtained also by dividing the deep epigastric vessels which cross the wound near its lower angle (Fig. 270) In the female, as the ureter nears the bladder it passes beneath the uterine artery which may be divided if necessary for better exposure. With the relaxation obtained under spinal anesthesia, I have had little trouble in exposing the ureter to the bladder through this incision. The end of the ureter is readily located by identifying the bladder in the lower extremity of the wound and tracing it down to the ureter.

The Paramedian Incision.—This incision is preferred by some surgeons for exposure of the lower portion of the ureter, especially when the juxtavesical portion is to be exposed. I see no advantage in this incision, unless the entire ureter is to be exposed for denervation or for an extensive plastic operation. The muscle-splitting incisions are less apt to result in hernia, partly because the incisions of the different muscle layers are not superimposed. Patients with muscle-splitting incisions usually can be permitted to get out of bed earlier. The paramedian incision begins just above the pubic bone, midway between the midline of the abdomen and the semilunar line, and extends upward for a distance depending upon the length of the ureter to be exposed (Fig. 271). For exposure of the lower end of the ureter the incision usually terminates opposite the umbilicus. The incision is carried through the anterior rectus sheath and the muscle is split along the course of its fibers. Several small blood vessels are torn as the muscle is split. The bleeding points are controlled by interrupted sutures over the torn vessels. The posterior rectus sheath, which is decidedly thicker above the semicircular fold, is then carefully incised to prevent injury to the underlying peritoneum. The peritoneum is rather closely attached in this area and some care is required in beginning its separation from the posterior sheath of the rectus. In this incision it is usually necessary to divide and ligate the deep epigastric vessels

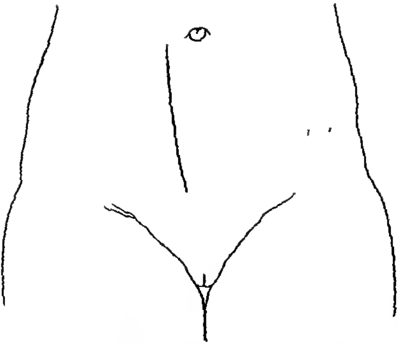

Fig 271 —Paramedian incision for exposure of the lower third of the ureter The incision is carried through the rectus muscle about two inches from its lateral margin thereby preserving a portion of the nerve supply to this muscle

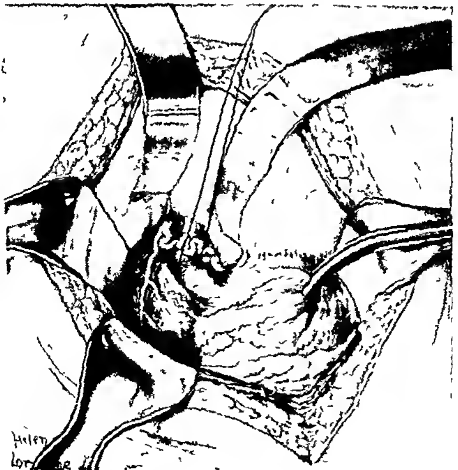

Fig —The lower portion of the ureter exposed to remove stone impacted near the bladder

above the symphysis pubis and curves outward and slightly upward to a point about an inch internal to the anterior superior spine of the ilium (Fig. 269). The external oblique aponeurosis is divided in the direction of its fibers An incision is then made in the fused aponeuroses of the internal oblique and transversalis muscles as they join to form the anterior sheath of the rectus, and these muscles are divided in the direction of their fibers. The transversalis fascia is divided (Fig. 270) and the peritoneum separated from the abdominal wall by blunt dissection, as previously described, and retracted medially. The ureter will be found in the depth of the wound attached to the posterior surface of the peritoneum. In the case of impacted stones periureteral adhesions sometimes bind the ureter and the peritoneum to the abdominal wall. In such cases it is better first to free the ureter above and below the inflammatory area. Loops of tape or catgut are placed around the ureter above and below the inflammatory mass and by gentle traction the ureter can be more easily identified and liberated. When the ureter is bound down by adhesions, the peritoneum may be torn in attempting to separate them. When this occurs, the peritoneum should be closed before the ureter is opened.

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which cross the wound diagonally from below and pass upward and inward The peritoneum is then detached from the abdominal wall and retracted medially and the ureter is exposed as previously described (Fig 272)

Vaginal Approach to the Ureter—As the ureter traverses the parametrium it lies less than an inch from the lateral vaginal fornix The patient is placed in the lithotomy position and under the relaxation of anesthesia a pelvic examination is made to determine whether the stone can be felt If the stone is palpable, the vagina is exposed with suitable retractors and the cervix is grasped with tenaculum forceps and drawn outward and downward in an opposite direction from the stone An incision is made through the vaginal wall, beginning at the lateral margin of the cervix and extending outward as

Fig [illegible]—Sagittal section of the pelvis showing relation of ureterovesical area to vagina and cervix Tip of finger inserted through lateral vaginal wall illustrates method of palpating stone in lower ureter through vaginal incision

far as possible (Figs 273 and 274) Traction on the cervix is relaxed slightly and the finger is inserted in the wound with the tip of the finger pointed laterally (Fig 275) The tissues are easily separated by finger dissection and the ureter and the impacted stone are palpated The uterine vessels can be palpated anteriorly and avoided The ureter is freed by finger dissection and brought into the wound (Fig 276) A loop of catgut or ureteral forceps are placed around the ureter above the stone to fix the ureter and to prevent the stone from slipping upward (Fig 276) The ureter is then incised and the

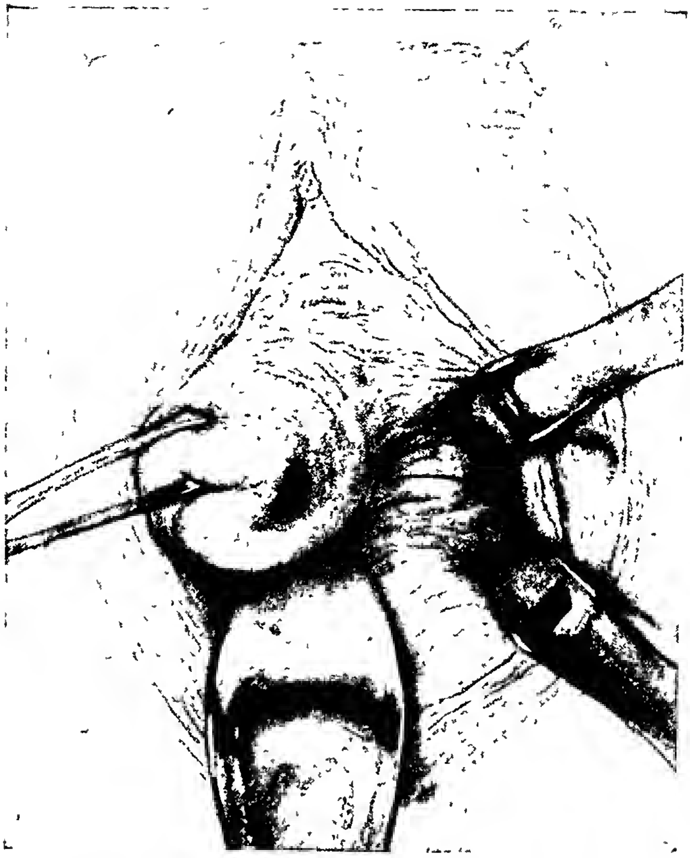

Fig 273 —Vaginal ureterotomy to remove stones impacted near the bladder With the cervix retracted a transverse incision is made in the upper vaginal wall, extending outward from the cervix.

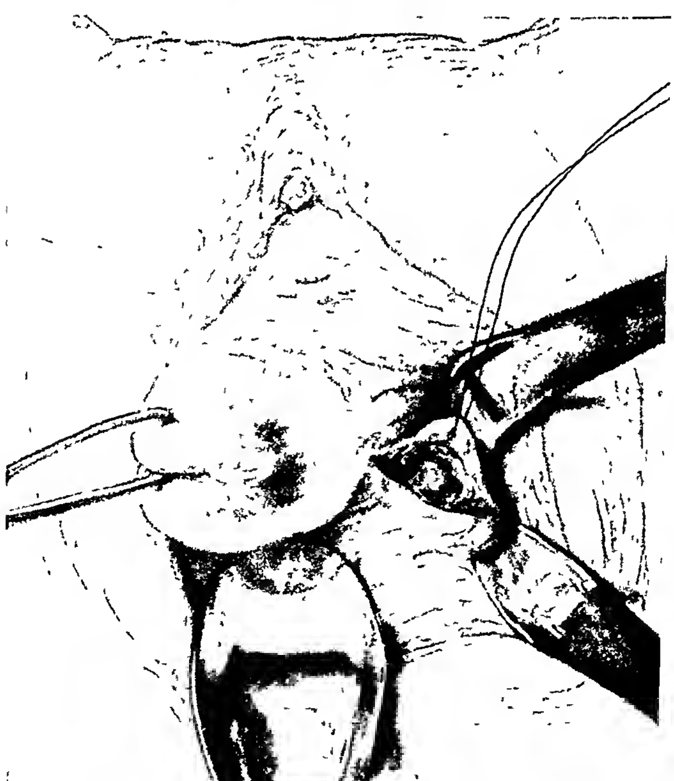

Fig 274 —The ureter is exposed as it runs near the lateral surface of the cervix

stone is removed The ureter should be sutured carefully with fine chromic catgut and replaced within the wound After inserting a small rubber tissue drain, the wound is closed with interrupted sutures of No 1 chromic catgut (Fig 277) In properly selected cases this is a safe and easy method of removing stones from the lower end of the ureter

The Transperitoneal Approach to the Ureter—It is occasionally necessary to expose the ureter transperitoneally It is the usual approach when transplanting the ureters into the sigmoid or rectum and is often the most satisfactory approach for treating ureterovaginal fistula When the ureter has been injured during an operation and repair is undertaken later, scar tissue may prevent extraperitoneal exposure The transperitoneal approach may be used to advantage when removing a stone from a ureter previously exposed extraperitoneally It is also useful for complete denervation for severe ureteral spasm With the patient in the Trendelenburg position the abdomen is opened near the midline, and the intestines are confined to the upper abdomen by packs of moist gauze The ureters are easily recognized as they cross over the brim of the pelvis and pass between the bifurcation of the iliac vessels and the peritoneum They can be traced in the pelvis until they disappear beneath the broad ligament in the female and the seminal vesicles in the male The ureter may be exposed in any area of the pelvis by incising the peritoneum over it

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Fig 276 —Loop of ureter containing stone grasped with forceps and delivered into vaginal wound After the stone is removed the ureter can be accurately sutured

Fig 277 —When the ureter is returned to its bed a strip of rubber tissue is inserted through the vaginal wound and the wound is closed with interrupted sutures of No 1 chromic catgut

may obscure the orifice, the ureter may end ectopically or a single ureter may divide above the bladder. A pyelogram, either intravenous or retrograde, is very helpful in such cases. An intravenous pyelogram will outline both pelves and ureters if the kidney function is adequate. When only one pelvis is filled by either method the picture is quite characteristic. The lower pelvis is lacking an upper calyx while the upper pelvis rarely drains more than one calyx.

Fig. 278.—Two ureters on left side. Atresia of abnormally placed orifice with small ureterocele. Small ulcer near orifice healed after the orifice was dilated.

ANOMALIES OF POSITION

Anomalies of position are usually associated with maldevelopment of the kidneys. In the horseshoe kidney the ureters pass over the isthmus to enter the nonrotated pelves anteriorly (Fig. 30). Drainage from horseshoe kidneys is frequently inadequate because of this anomalous position of the ureters. The condition may be partially corrected and drainage greatly improved by dividing the isthmus of the horseshoe kidney and correcting the faulty position of the kidneys by nephropexy when indicated. In ectopic kidneys the ureters are greatly shortened (Fig. 103) while in cases of crossed dystopy and in fused kidney the ureter to the abnormally placed kidney leaves the bladder from a normally placed orifice and crosses the midline to reach the kidney (Figs. 29 and 104). Such anomalies may cause some confusion in diagnosis. Bilateral pyelograms give a satisfactory interpretation of the condition. A few cases have been reported in which the ureter left the bladder along a normal course then completely encircled the vena cava in a spiral manner and entered a normally placed kidney pelvis. Drainage of the kidney has been inadequate in all such cases reported. Kimbrough reported such a case in which he divided the ureter, disengaged it from its faulty position and did an end to end anastomosis with excellent results.

CHAPTER XIX

CONGENITAL ANOMALIES OF THE URETER AND THEIR TREATMENT

Anomalies of Number, Position, and Implantation; Congenital Strictures, Valves, Diverticula, Kinks; Ureterocele; Megaloureter

Anomalies of the ureters are among the most frequent congenital defects The ureter may be absent or rudimentary on one side or duplicated on one or both sides without producing clinical evidence of the abnormality. Anomalies of position are likewise compatible with normal kidney function. There is little doubt, however, that a larger percentage of kidneys with multiple ureters or ureters that take an abnormal course suffers from defective drainage than kidneys with one ureter in a normal position.

ANOMALIES OF NUMBER

Complete absence of a ureter and of its accompanying kidney results from failure of the proper anlage to develop. Occasionally a rudimentary ureter is present. The possibility of such an anomaly should always be thought of when an operation upon the kidney is indicated. Operations upon the kidney are rarely so urgent that the presence and condition of the opposite kidney cannot be determined Duplication of the ureters occurs rather frequently (Fig 278) The duplication may be complete when two ureters grow independently from the Wolffian duct or incomplete when a single ureter divides, forming a bifid ureter before joining the kidney. Duplication of ureters may be unilateral or bilateral (Figs 28 and 32). Kidneys drained by two ureters have two separate pelves. The upper pelvis is much smaller than the lower pelvis, frequently having only one major calyx. Where there is complete duplication, the ureter draining the upper pelvis enters the bladder below the orifice of the ureter draining the lower pelvis of the kidney. Although such duplicated ureters and kidneys often function normally, the caliber of one or both ureters may be smaller than normal and congenital strictures and ureteroceles are encountered more frequently than in single ureters. In some cases an extra ureter fails to become connected with the kidney, but ends blindly near the kidney. Engel reported two such cases, in one of which the aberrant ureter was removed because of persistent pain Supernumerary ureters are also frequently encountered among the anomalies of implantation.

Duplication of the ureters may cause some confusion in diagnosis when the accessory ureter is not readily recognized. Severe inflammation of the bladder

irritation, abdominal pain, backache, and gastrointestinal disturbances are not unusual. In infection, these symptoms are exaggerated and accompanied by fever and pyuria. In bilateral obstruction without infection the clinical course and laboratory findings may simulate nephritis. The diagnosis is made by a complete urological study which is too often omitted in children with vague abdominal complaints, indigestion, and poor general development. Intravenous urography is an excellent diagnostic procedure in children with complaints suggesting pathology of the urinary tract.

Treatment.—Strictures in the lower ureter are often amenable to ureteral dilatation and instruments of small caliber are available for this purpose. If the stricture is not dilatable and the kidney has good function or is capable of improvement, the ureter may be divided and re-implanted into the bladder or the stricture may be excised and an end-to-end anastomosis done. Ureterovesical anastomosis is preferable when the stricture is not too far from the bladder. In the ureteropelvic area operation is always necessary. A number of plastic operations are available. The stricture may be divided longitudinally and sutured transversely, operated upon by Foley's method, a Ramstedt operation may be done, or the ureter may be divided and re-implanted into the kidney pelvis. If the kidney pelvis is dilated the redundant portion should be excised. Plastic operations should not be done in the presence of advanced infection. If the condition is unilateral and the kidney decidedly damaged, a nephrectomy is the wisest course. In bilateral cases, nephrostomy on both kidneys may be necessary; this can be maintained indefinitely unless plastic procedures are later justified. In reduplicated ureters heminephrectomy can usually be done.

CONGENITAL VALVES

Transverse folds of the ureteral mucosa are frequently found at autopsy in the fetus and in the newborn, but rarely after the fourth month of life. They occasionally persist and cause obstruction. They are most frequently found in the lower part of the ureter and are recognized by transverse filling defects in the ureterogram.

Treatment.—If the condition is unilateral ureteronephrectomy is indicated; if bilateral, nephrostomy will preserve the kidney function until the obstruction in the ureters can be corrected by plastic procedures.

DIVERTICULUM

Diverticula of the ureter are rarely encountered. In most cases they result from a blindly ending ureteral bud. They usually occur in the lower end of the ureter. Globular dilatation of the ureterovesical junction is sometimes difficult to differentiate from a diverticulum of the bladder.

The symptoms are usually pain in the loin and pyuria which result from obstruction and infection. The condition is recognized in the ureterogram

ABNORMAL IMPLANTATION

Because of misdirected embryological growth the ureter may end outside the bladder. In the female the ureters may open into the urethra, the vestibule, the vagina, the uterus or the fallopian tubes. In the male the urethra, vas deferens, seminal vesicles or ejaculatory ducts may be the site of abnormal implantation. Implantations into the bowel or urachus may occur in both sexes. Most of these faulty implantations are associated with other anomalies in monsters or in stillborn infants. Clinical cases are seen much more frequently in the female. The ectopic orifice usually occurs below the sphincter and incontinence of urine calls attention to the anomaly. Incontinence of urine because of ectopic ureteral implantation is usually accompanied by normal bladder function. Frequently two normally placed ureteral orifices are found in the bladder while the ectopic ureter drains the upper pole of a double kidney. Occasionally bilateral accessory ureters end ectopically or both single ureters may have ectopic openings. In the male the implantation may be above the external sphincter and is only located when symptoms of infection or obstruction lead to a careful urological examination. Treatment depends upon the condition of the kidney or that portion of the kidney drained by the misplaced ureter. If renal function has not been too greatly impaired, transplantation of the ureter into the bladder is the most satisfactory procedure. Occasionally in ectopy of an accessory ureter the ectopic ureter may be anastomosed to the normal ureter. If the urine is sterile the ureter may be ligated with a reasonable chance of relief. In most cases because of faulty drainage the anomaly is accompanied by hydronephrosis which in many instances has progressed to complete destruction of renal function. When the ectopic ureter drains a portion of a double kidney heminephrectomy is indicated if the half of the kidney draining into the bladder is in a healthy condition. The anomalous ureter, if greatly dilated, should be removed In single ureters when the lesion is bilateral, conservative methods are essential, while if the lesion is unilateral and the kidney is damaged by hydronephrosis or infection, nephrectomy is the best procedure.

CONGENITAL URETERAL STRICTURES

Congenital strictures are the most common cause of ureteral obstruction in infants and children. They usually occur at the areas of normal ureteral narrowing and are most frequently found at the ureterovesical junction and just below the renal pelvis. The strictures vary from perceptible narrowing to impassable obstruction, and are frequently multiple. They may be broad and involve several millimeters of the ureter or may be sharply localized. They frequently occur in reduplicated ureters and one or both ureters may be involved. Congenital strictures occasionally cause, or at least are associated with, megaloureter and are the most frequent cause of massive hydronephrosis in children. The symptoms are those of renal obstruction, and reflex vesical

the margin of the ureteral mucosa is sutured to that of the bladder Following treatment of the cyst, the kidney, if infected, should be treated by pelvic lavage and urinary antiseptics Occasionally the kidney may be so severely damaged that nephrectomy is advisable or, in the case of duplication of the ureters, heminephrectomy may be indicated

MEGALOURETER

In 1923 John R Caulk reported a case of enormous dilatation of the ureter with normal kidney function and a normal appearing ureteral orifice He discussed the similarity between this condition and megalocolon and designated it megaloureter Since the report of this case many reports of excessively large ureters have appeared in the literature and a number of authors have used the term megaloureter to designate all cases of excessive dilatation of the ureter Eisenstaedt in 1925 reported two cases of enormously dilated ureters and kidney pelves in children in which the ureteral orifices were dilated and inactive and in which there was no evidence of obstruction Hinman defines megaloureter as a condition in which there are achalasia of the ureteral orifice, a gigantic ureter, and a normal pelvis and calyces He differentiates the condition from dilatation of the ureters resulting from congenital obstruction, in which there are accompanying pyelectasis and destruction of renal tissue, and from neurological disturbances of the urinary tract in which the ureteral orifices are relaxed and the kidney pelves dilated

Some degree of ureteral dilatation is always found in congenital obstruction of the bladder and urethra (Fig 282) In stillborn infants with congenital valves or stenosis of the urethra the ureters are greatly dilated and the parenchyma of the kidney is destroyed by hydronephrosis When the obstruction is incomplete, dilatation of the ureter and the kidney pelvis progresses more slowly and continues into childhood and in some cases is recognized in the adult In these cases ureteral dilatation results from increased intravesical tension with the resulting hypertrophy and later dilatation of the bladder The ureteral orifices become incompetent and eventually dilated, with regurgitation of the bladder contents into the ureters The tremendous dilatation of the ureters as contrasted with the moderate dilatation encountered in obstructive lesions in the adult may be accounted for by two factors The most important is the element of time Congenital obstructive lesions do not progress so rapidly and the condition may exist for many years before being recognized In the second place the child's ureter is larger in proportion than that of the adult and is doubtless less capable of withstanding back pressure

Stenosis of the ureteral orifice with or without ureterocele may be accompanied by dilatation of the ureter and the kidney pelvis The obstruction is very probably congenital and gradually progressive If infection is added, obstruction is increased and the ureteral wall becomes less able to compensate

The ureters and the kidney pelves are dilated in neurogenic disturbances of the urinary tract accompanying spina bifida or other defects of the spinal cord The bladder contains a constant residual but no obstructive lesion can be

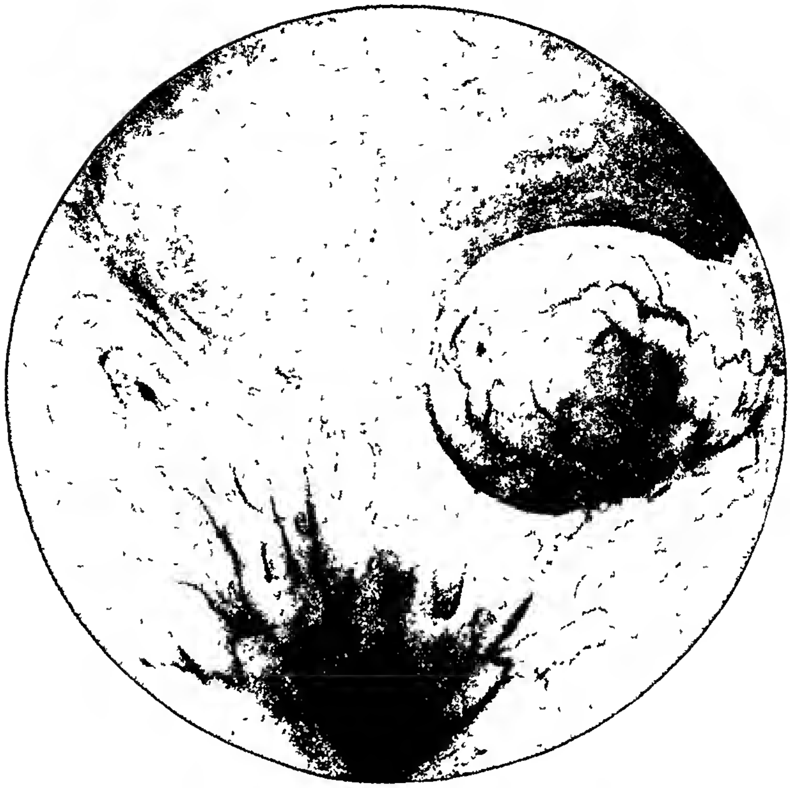

Fig 280—Cystoscopic appearance of ureterocele.

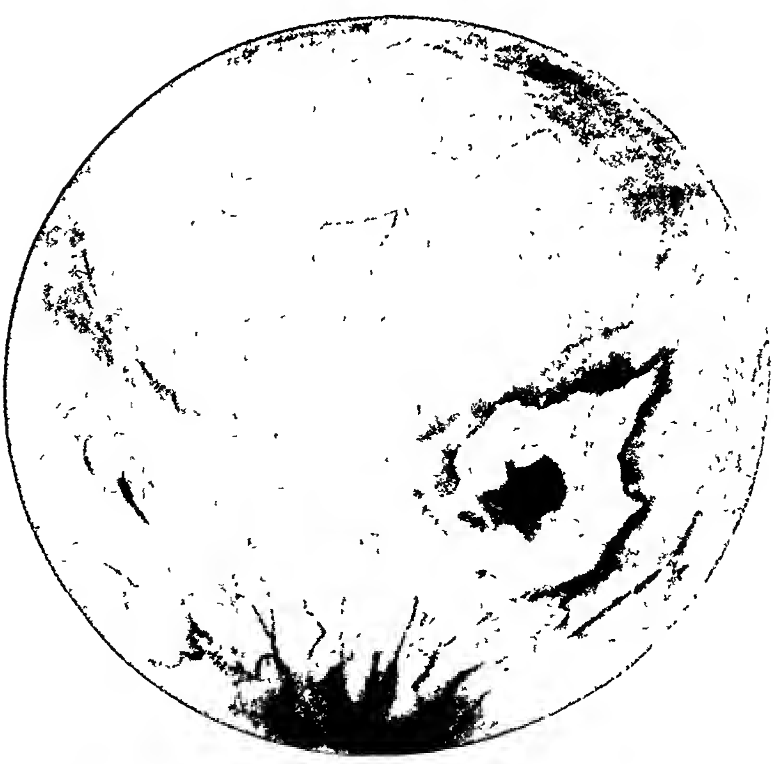

Fig 281.—Ureterocele excised with high-frequency electrode

When the condition is recognized clinically it is impossible to determine whether the inelastic condition of the intramural portion of the ureter, often mentioned as a causative factor, is congenital or results from secondary fibrotic change

Treatment—Treatment is directed toward improvement in drainage regardless of the location of the obstructive lesion Operative procedures for the correction of obstructive factors distal to the bladder and for the improvement of neurogenic disturbances of the bladder are discussed elsewhere Chapters XXVIII and XXXIII Treatment applied to the ureter consists of dilata

Fig 283—Megaloureter in a child six years old

tion of the ureteral orifice Plastic operations for enlargement of the ureteral orifice plastic operations upon the ureter, and ureteronephrectomy may be considered

Dilatation of the ureteral orifice with bougie and large catheters and prolonged drainage of the kidney by an indwelling ureteral catheter produce great improvement in the less extensive cases When there is marked fibrosis of the intramural portion of the ureter, dilatation does not give lasting *results* The most satisfactory method of permanently enlarging the ureteral orifice is

found, the orifices of the bladder and ureters are relaxed, and because of decreased tone of the bladder muscles dilatation of the ureters and destruction of renal function progress more slowly than in cases of obstruction.

Dilated ureters unassociated with obstruction or demonstrable neurogenic lesions are more difficult to explain. The condition is often unilateral and frequently the dilatation is confined almost exclusively to the ureter, the kidney

Fig 282—Dilatation of bladder, left ureter, and renal pelvis, resulting from congenital valves of the posterior urethra

pelvis showing very little change. These cases most probably have their foundation in faulty embryological development of the muscular coats of the ureter. Valves in the lower ureter are a frequent finding in necropsies on the newborn They are rarely found in older children If such valves do not disappear, dilatation of the ureter will result. Deficiency of the ureterovesical valve, permitting regurgitation from the bladder, explains hydroureter in some cases

Hinman has eliminated longitudinal redundancy and improved the uretero vesical orifice by freeing the lower portion of the ureter, dividing it at the bladder wall and drawing the freed end of the ureter into the bladder either by dilating the orifice for the reinsertion of the ureter or by making a new opening After the end of the ureter has been drawn through the bladder wall the excess portion of ureter is excised and the ureterovesical anastomosis is completed Granville Crabtree has successfully reduced the caliber and the length of dilated ureters by excising a longitudinal strip of the ureteral wall and reconstructing the ureteral lumen over a small urethral catheter If excessive length is to be disposed of the ureter is divided and re implanted into the bladder after excising the excessive length

When the condition is unilateral with a normal kidney and ureter on the opposite side, nephroureterectomy is usually the preferred treatment This is particularly true when the dilated ureter is complicated by infection (Figs 283 and 284)

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section of the orifice through the bladder wall and adjacent ureteral wall, after which the mucous membrane of the ureter is sutured to the mucous membrane of the bladder.

Fig 284 —Megaloureter (Fig 283) specimen removed at operation

The megaloureter with redundancy both laterally and longitudinally, and with a thin fibrotic wall often completely lacking in peristaltic motion, is in itself a source of obstruction to the flow of urine from the kidney. Excessive length of the ureter may be decreased and obstructing kinks removed by resecting portions of the ureter and uniting the remaining segments end-to-end. The operation is relatively easy because of the excessive caliber of the ureter.

Hinman has eliminated longitudinal redundancy and improved the uretero vesical orifice by freeing the lower portion of the ureter, dividing it at the bladder wall and drawing the freed end of the ureter into the bladder either by dilating the orifice for the reinsertion of the ureter or by making a new opening After the end of the ureter has been drawn through the bladder wall the excess portion of ureter is excised and the ureterovesical anastomosis is completed Granville Crabtree has successfully reduced the caliber and the length of dilated ureters by excising a longitudinal strip of the ureteral wall and reconstructing the ureteral lumen over a small urethral catheter If excessive length is to be disposed of the ureter is divided and re implanted into the bladder after excising the excessive length

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CHAPTER XX

SURGICAL DISEASES OF THE URETER AND THEIR TREATMENT

PYOURETER

Pyoureter may accompany pyonephrosis or may develop following nephrectomy. Latchem has shown experimentally that following nephrectomy the mucous membrane of the unobstructed ureter is unchanged but the muscular coat atrophies. If the ureter is obstructed, in addition to dilatation of its lumen, there is decided hypertrophy of the muscular coat, especially of the circular fibers. If the obstructed ureter is infected the lumen becomes distended with purulent material. There is round cell infiltration throughout the ureteral wall and eventually rather dense periureteral adhesions result.

Pyoureter most frequently occurs when a stone has been left in the ureter following nephrectomy, although cases have been reported in which the ureter was obstructed by a stricture, and following nephrectomy for tuberculosis. The interval between nephrectomy and the onset of symptoms indicative of pyoureter varies from a few weeks to several years. Pyuria, frequent and painful urination, tenderness and pain along the course of the ureter, and persistent sinus in the nephrectomy wound are the usual clinical manifestations.

Treatment.—In some cases adequate drainage can be established and the condition relieved by dilating and irrigating the ureter or by the removal of an impacted stone. The segment of ureter above the stone should be removed when practical. When the ureter is greatly dilated and tortuous, ureterectomy, either partial or complete, is necessary to ensure a permanent cure. This is particularly true when the infection is tuberculous

Most cases of pyoureter can be prevented by adequate treatment of the ureter when nephrectomy is done. If good drainage cannot be assured, the ureter should be removed either at the time of nephrectomy or as soon thereafter as the patient's condition will permit. If ureterectomy becomes necessary at a later time, the operation will be more difficult because of periureteritis and adhesions Small stones may be left in the ureter following nephrectomy without danger of discomfort to the patient when the ureter is free of infection. When the ureter is dilated and contains purulent material at the time of nephrectomy, pyoureter may be expected unless the stone or ureter is removed. The same principle should be followed when removing a tuberculous kidney. If drainage of the ureter is inadequate it will remain an active source of infection.

PAINFUL URETERAL SPASM

It has been demonstrated clinically by Wharton and experimentally by Andler that all nerves passing directly to the ureter can be divided without

interfering in any way with ureteral function To accomplish this it is necessary to free the ureter entirely, from the bladder to the kidney pelvis

Denervation is indicated when painful spasm of the ureter cannot be reasonably well controlled by palliative means Painful ureteral spasm is not infrequently seen in urological and gynecological practice

The symptoms indicate varying degrees of ureteral obstruction There may be continuous dull pain or severe attacks of ureteral colic Frequently the pain is felt in the loin but is more constant and severe along the course of the ureter Thorough urological examination is apt to show the kidneys and ureters to be anatomically and functionally entirely normal In some cases the ureter seems to grip the catheter as it is passed and the ureterogram may indicate spasticity of the ureter

Many of these patients have had abdominal operations or repeated dilatations of the ureters without relief In mild cases benefit is obtained by antispasmodic drugs and occasionally gentle dilatation of the ureter gives relief for a time

Surgical Treatment

Technique of Operation—Denervation may be accomplished extraperitoneally or transperitoneally In the female, in whom most cases of ureteral spasm occur, the transperitoneal approach is preferable This gives an opportunity to correct any lesion of the pelvic organs that may exist It is also the best approach when both ureters are to be denervated A long paramedian incision is made and the intestines are held away from the side to be operated upon with moist gauze The ureter is recognized as it passes over the pelvic brim and courses along the posterior wall of the pelvis beneath the peritoneum The peritoneum is divided over the ureter throughout its pelvic course The ureter is then picked up and separated from the retroperitoneal tissue dividing all bands of adhesions, blood vessels and nerves, so that it is completely free from any attachments from the bladder, until it disappears above the pelvic brim The ureter should not be closely stripped, but all adventitia should be left intact (Fig 285) Slight oozing from the ureteral bed can be controlled by hot packs It may be necessary to ligate a few bleeding points The upper angle of the wound in the posterior peritoneum is then retracted forward and with the finger the ureter is separated as far upward as one can reach The colon is then retracted medially and an incision is made in the peritoneum over the upper portion of the ureter and the ureter is freed to the renal pelvis A stab wound is then made just medial to the anterior superior spine of the ilium and a rubber tissue drain is carried down retroperitoneally to the ureter The incisions in the peritoneum over the ureter are closed with continuous sutures of chromic catgut The abdominal wound is closed without drainage If the ureter is to be exposed extraperitoneally, a paramedian incision is preferable It permits exposure of the entire ureter through one incision without cutting across any muscles The incision extends from the pubis to about three inches above the navel After the incision has been carried through the posterior sheath of the rectus muscle and all bleeding has been controlled, the peritoneum

Fig 285.—Denervation of right ureter, transperitoneal exposure

is separated from the abdominal wall and retracted medially until the ureter is exposed The ureter is then entirely liberated, from the bladder to the kidney pelvis Bleeding is controlled and a rubber tissue drain is placed near the lower end of the ureter and brought out through a stab wound near the anterior superior spine of the ilium The abdominal wound is closed in layers, accurately approximating the anterior and posterior sheaths of the rectus muscle

This operation is decidedly helpful when clearly indicated The patient should, however, be observed for sufficient time before being operated upon to eliminate any demonstrable pathological lesion as cause of the pain, either in the urinary tract or elsewhere During this time palliative measures, including the removal of foci of infection, rest and the administration of antispasmodic drugs should be used

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CHAPTER XXI

URETERAL CALCULI AND THEIR TREATMENT

General Considerations, Ureterotomy, Ureterostomy

Ureteral calculi with few exceptions originate in the kidney. The normal constrictions of the ureter present natural barriers to the passage of a stone, and it is at, or near, these areas that a calculus usually lodges. Pathological strictures or spasm of the ureter may account for the arrest of calculi in any portion of the ureter. When the stone has been arrested in the ureter for a time, varying from a few hours to several days, the spasm may relax, or the ureter may become sufficiently dilated from above to permit the stone to continue down the ureter. This process may be repeated several times before the stone is eventually expelled. When the stone fits very tightly in the ureter or when the spasm persists, the ureteral wall becomes edematous and often completes the occlusion of the channel. The stone is then impacted and rarely moves further unless assisted. If this impaction is not promptly relieved, inflammatory changes take place in the ureteral wall, followed later by fibrosis and often permanent injury to the ureter. Sufficient drainage may occur around the stone to preserve the kidney function. In long-standing cases grooves are sometimes noted in the stone. In most cases stones that have existed for several weeks are accompanied by some dilatation of the ureter and kidney pelvis, with diminution of the renal function. Not infrequently the kidney is irreparably damaged or destroyed. Most of the arrested ureteral calculi, about 75 per cent, pass the two upper constrictions and lodge in the pelvic segment The ureterovesical area is the narrowest and most resistant portion of the ureter.

Choice of Treatment.—It is possible now to remove the majority of ureteral calculi by cystoscopic procedures. This is accomplished most frequently by dislodging the stone and dilating the ureter with catheters and bougies aided by lubrication and the administration of relaxing drugs. Frequently two or more catheters may be passed by the stone and left in place a few hours for drainage of the kidney and dilatation of the ureter. When they are removed, the stone often comes away with them or is passed shortly thereafter. Many special instruments have been devised to aid in the removal of these stones, some to aid in increasing the caliber of the ureter, and others to grasp or entangle the stone and extract it from the ureter. The usefulness of these instruments is limited. They are usually semirigid, hence their introduction into the ureter is not without danger. Reports of ruptured ureters have increased since their introduction. A few are helpful accessories in the hands of skilled cystoscopists. A sizable proportion of ureteral calculi, approximately 20 per

cent according to some writers and decidedly more in the opinion of others, should be removed by ureterolithotomy. The decision for open operation depends upon many factors, varying from the size and location of the stone to the temperament of the patient.

Size and Location.—Some authors attempt to designate the upper limit in size at which a stone may be removed by cystoscopic procedure; some state that a stone larger than a centimeter in its greatest dimension should be removed by ureterolithotomy, while others feel that attempts should be made to remove stones twice as large by cystoscopic manipulation (Figs. 286 and 287). So many other factors enter into the problem that such a standard is of little value. A small, spastic ureter, a dense, unyielding condition of the intramural segment, inflammatory reaction around the stone, and distortion of the base of the bladder are occasional handicaps that are difficult to overcome. When they are met, it is often to the patient's advantage to remove the stone by open operation. The location of the stone when first seen is of considerable importance in deciding upon the method of treatment (Figs. 288, 289, and 290). I

Fig. 286.

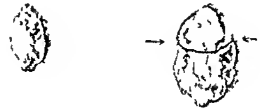

Fig. 287.

Fig. 286.—Calcium oxalate ureteral calculus. This size stone is usually removed by cystoscopic treatment.

Fig. 287.—Two stones removed from the ureter by cystoscopic treatment; natural size. The ureter was greatly dilated. Ureteral orifice enlarged by high frequency electrode.

agree with Foley that any stone larger than five millimeters in diameter impacted above the point at which the ureter crosses the iliac vessels should be removed by ureterolithotomy without delay. In such a case the stone has yet to traverse the narrowest portion of the ureter, and if it becomes impacted near the bladder it is more difficult to expose by open operation. On the other hand, removal of a stone from the upper portion of the ureter is one of the easiest and safest urological operations. Operation in this area *becomes imperative* if there is evidence of infection or if the stone is not readily passed by manipulation with a ureteral catheter.

The Duration of Symptoms.—The duration of symptoms is also *important*. If the history and examination indicate that the stone has remained in the ureter for a long time, cystoscopic methods are less apt to be successful. The segment of ureter surrounding the stone is often thickened and *inelastic, and* in some cases spicules of stone are imbedded in the ureteral wall. It is correctly stated

that many stones of long residence in the ureter contain grooves which permit drainage and protect the kidney It is equally true that stones lying silently in the ureter may cause complete destruction of the kidney. If there is evidence of urinary stasis or diminution of kidney function, prompt removal of the stone is the safest procedure

Fig 288 —Stone impacted in lower third of left ureter Small stone in right kidney

Infection.—Mild degrees of infection may be controlled by one or more indwelling ureteral catheters while efforts are made to extract a stone, but if the infection is severe, with high fever or chills and fever, immediate operation is necessary. If the stone is accompanied by severe infection with rapid pulse rate, abdominal distention and acute lumbar tenderness, nephrostomy or nephrectomy may be the operation of choice In such cases it should be remembered that a

badly infected kidney will usually recover if adequate drainage is instituted. In some cases a small stone will pass unaided while nephrostomy drainage is in progress, if not, it can be removed later under more favorable conditions.

Anuria.—Anuria occurs in bilateral ureteral calculi when only one kidney is blocked and when the uninvolved kidney ceases to function because of obstruction of the opposite ureter. This condition is spoken of as reflex anuria and is probably caused by the entire burden of excretion being thrown suddenly on a kidney whose functional capacity is insufficient for the task. It is doubtful whether reflex anuria ever occurs when the uninvolved kidney is entirely normal.

Fig. 289.—Stone in lower third of right ureter.

Treatment in these cases is influenced to some extent by the length of time the anuria has existed. If the stone is small and recently impacted, excretion of urine may be re-established by the passage of one or more catheters by the stone. If after the catheters are removed the stone is not passed within a few days, or if there is evidence of infection or a recurrence of anuria, ureterolithotomy should be done immediately. If the stone is of sufficient size to make its expulsion from the ureter doubtful, or if the anuria is accompanied by fever, immediate

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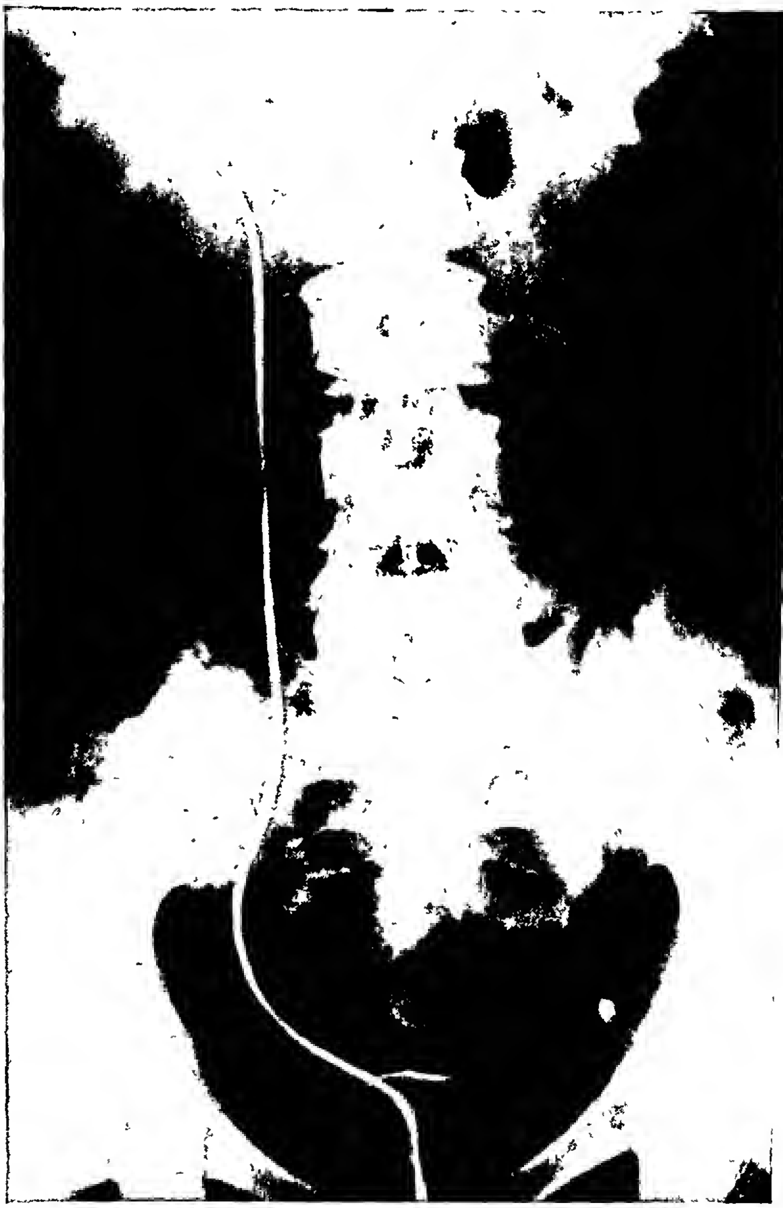

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be removed through a vaginal incision When the stone can be palpated through the vagina, this is the best means of approach The operation is exceedingly simple and safe The fear of ureterovaginal fistula is in my experience unfounded

Age—Fortunately ureteral stones are not seen very often in children and elderly people In children the various instruments devised for the extraction of stones are not applicable because of their size Small stones will often pass, following dilatation of the ureter with one or two small catheters Elderly people do not tolerate repeated instrumental efforts to dislodge ureteral calculi Only small stones that give promise of easy passage should be treated by this method Frequently enlargement of the prostate will prevent cystoscopic efforts at removal Such patients should be carefully studied and the gentlest method possible should be used

The Patient's Attitude—The patient's attitude toward the treatment must be considered also Some patients are very fearful of surgical procedures and will tolerate any number of cystoscopic efforts rather than submit to operation There are others who are very intolerant of pain and react to cystoscopic manipulation very badly If it is necessary to subject a patient to general or spinal anesthesia several times within a few weeks to manipulate a stone, it is far better that operation be done in the beginning Economic factors also enter into the choice of procedures especially with patients who have come some distance for treatment When following examination, it seems probable that several treatments will be necessary for the removal of a stone cystoscopically, it is usually better to remove the stone immediately

Cystoscopic Treatment

The primary purpose of cystoscopic treatment in cases of ureteral calculi is dilatation of the ureter Many stones will pass following this treatment alone, and it is a necessary preliminary procedure to other forms of ureteral manipulation The most satisfactory method of dilating the ureter is the passage of multiple catheters or bougies aided by the relaxing effect of antispasmodic medication (Fig 291) Avertin has a relaxing effect on the ureter when given either rectally or by injection directly into the ureter Spinal anesthesia completely relaxes the ureter and is probably the greatest single aid in manipulations within the ureter It should not be repeated at frequent intervals Papaverine, calcium gluconate, and deproteinized pancreatic extract have definite relaxing effect upon the ureteral muscles When only one ureteral catheter can be passed by a stone it should be left in place for drainage and relaxation of ureteral spasm It is a mistake to withdraw a small catheter with the hope of replacing it with a larger one, the effort is often unsuccessful It is often surprising how much easier it is to pass additional catheters after a catheter has remained in the ureter for two or three days If two or more catheters can be passed by a stone, they should be left in place from twelve to twenty four hours, then twisted and withdrawn together The stone will often come away with the catheters If it does not, it may be passed shortly following their removal For this purpose three or four small catheters are of greater value than two large catheters When a stone has become enmeshed in twisted catheters, considerable resistance may be

operation is the safest procedure. In cases of prolonged anuria with evidence of uremia or sepsis, nephrostomy should be done for drainage and protection of the kidney. The stone, unless it can be reached through the kidney incision, may be removed when conditions are more favorable. Bilateral ureteral calculi are always a serious problem. If possible ureteral catheters should be passed above the stones and left in place for drainage. The stones may then be removed at separate operations a few days apart, or one stone if small may be removed by cystoscopic methods following operation on the opposite side. The operative risk is greatly increased in bilateral operations. They should be avoided unless infection or anuria requires immediate drainage of both kidneys.

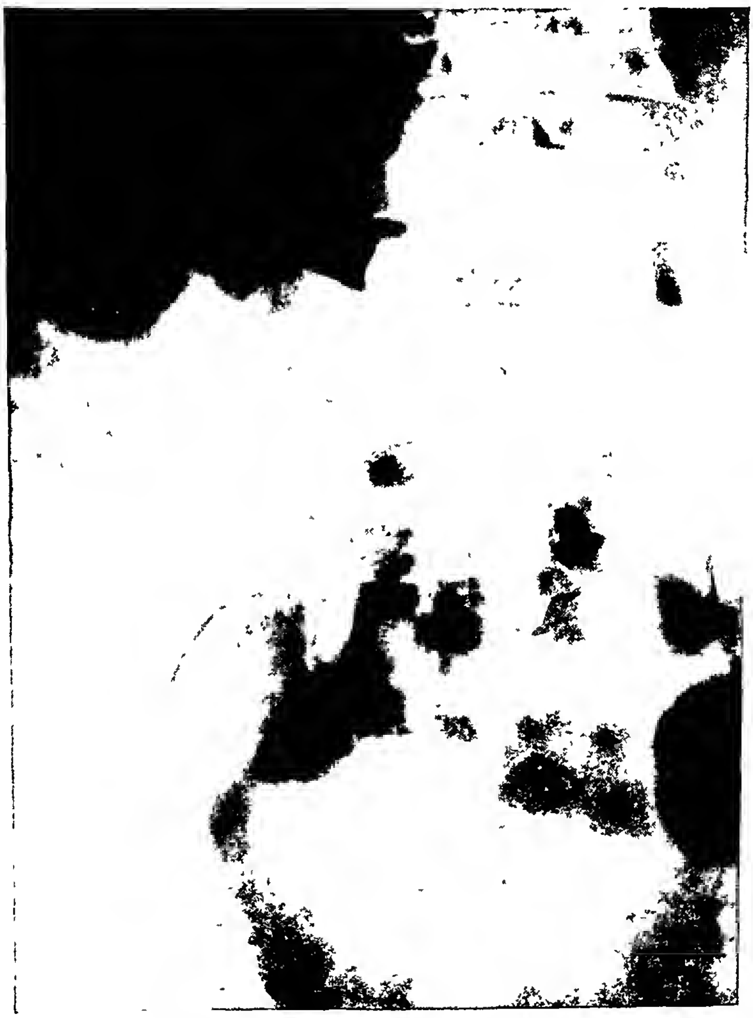
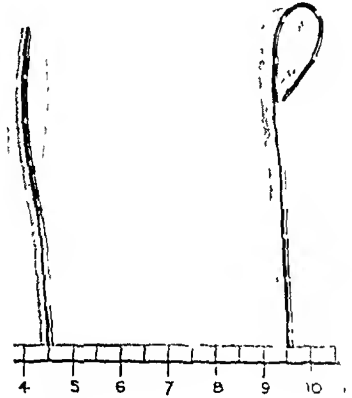


Fig 290—Stone lodged in middle third of right ureter Ureter constricted where it crosses iliac vessels

Sex.—Cystoscopic procedures are better tolerated by women, and consequently probably a greater percentage of stones can be removed by this method than in the male. The cystoscope can be passed readily by the side of indwelling ureteral catheters, making it possible to pass a greater number of catheters by a stone in the female ureter. Stones impacted in the lower end of the ureter may

about three hours The multiple catheter method has the following advantages The ureter is protected from the stone by the catheters, the kidney is drained while the catheters are in place, and if the stone becomes enmeshed and cannot be delivered, the catheters can be untwisted and removed separately or left in place longer for drainage according to indications

The Bilkus modification of the Zeiss looped catheter is also a useful method of removing small stones from the ureter (Fig 292)



A B

Fig 292—Looped catheter for extraction of ureteral stones A Ready to be introdu
Loop formed in renal pelvis is withdrawn slowly The stone is frequentl in

Many instruments for dislodging and removing stones from
been devised They require dilatation of the ureter to a size l
stone before they can be employed successfully Because of their
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met in an effort to withdraw them. This resistance may be overcome partly by the administration of relaxing drugs. Jarman and Scott advocate the injection of 2 per cent Avertin solution through the ureteral catheters fifteen minutes

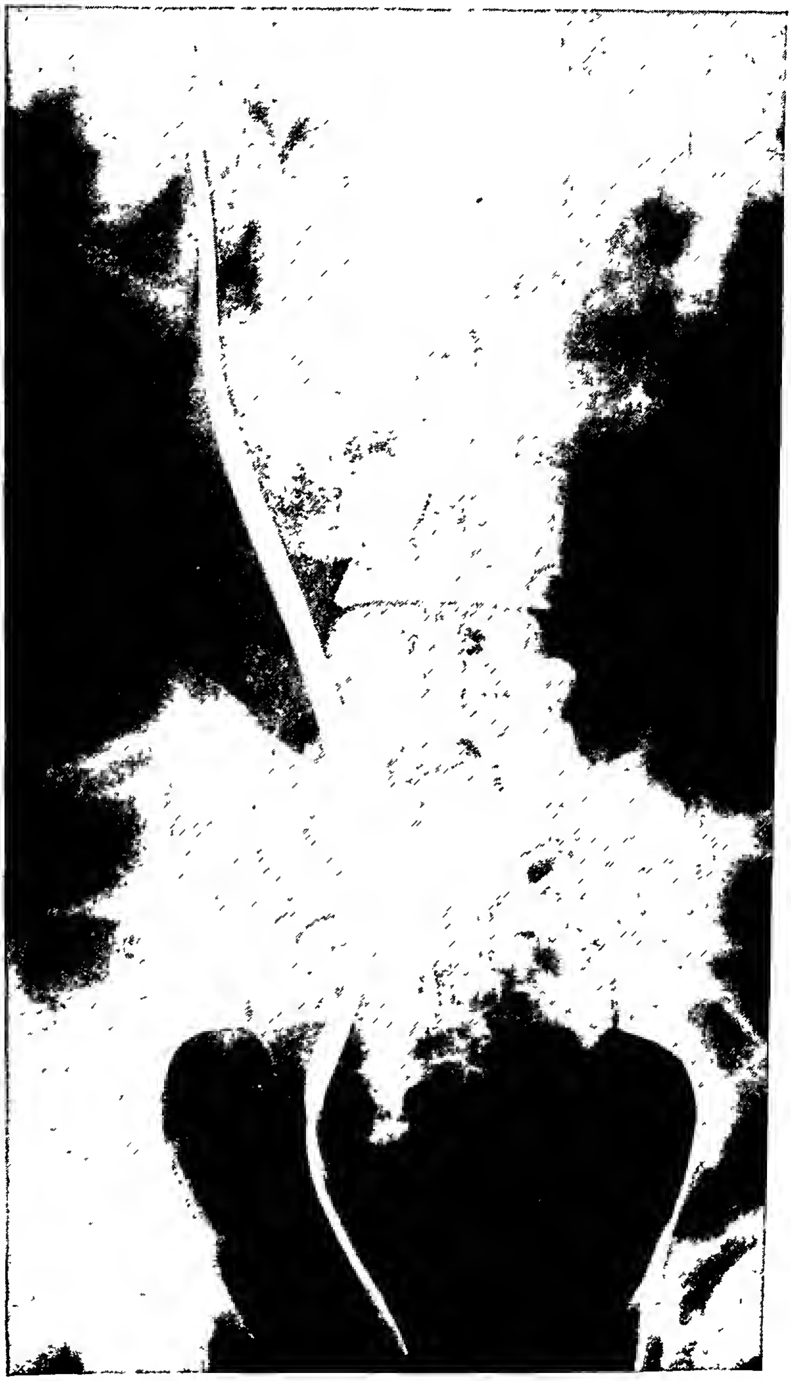

Fig 291.—Stone in right ureter surrounded by three ureteral catheters The stone was removed with the catheters

before removing them; Alyea uses spinal anesthesia. When the catheters cannot be removed without too great force, Alyea advises continuous elastic traction. This method has been successful in my own practice; the stone comes away in

about three hours The multiple catheter method has the following advantages The ureter is protected from the stone by the catheters, the kidney is drained while the catheters are in place, and if the stone becomes enmeshed and cannot be delivered, the catheters can be untwisted and removed separately or left in place longer for drainage according to indications

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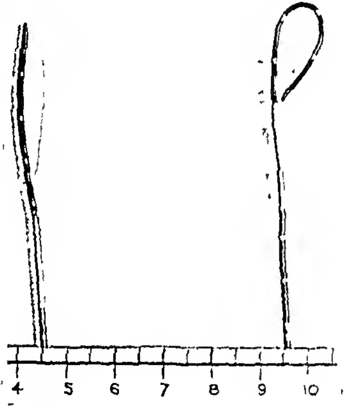

Fig 292—Looped catheter for extraction of ureteral stones A Ready to be introduced B Loop formed in renal pelvis is withdrawn slowly The stone is frequently caught in the loop

Many instruments for dislodging and removing stones from the ureter have been devised They require dilatation of the ureter to a size larger than the stone before they can be employed successfully Because of their semirigid character they require considerable refinement in technique before they can be used without danger to the ureter They should never be passed beyond the lower third of the ureter and, when a stone becomes engaged and cannot be removed, ureterotomy may be necessary to remove the stone and instrument When such an incident occurs, elastic traction by a rubber band may succeed in the gradual extraction of the instrument and the stone These instruments have the advantage that in skilled hands the stone often can be removed while the patient is on

met in an effort to withdraw them. This resistance may be overcome partly by the administration of relaxing drugs. Jarman and Scott advocate the injection of 2 per cent Avertin solution through the ureteral catheters fifteen minutes

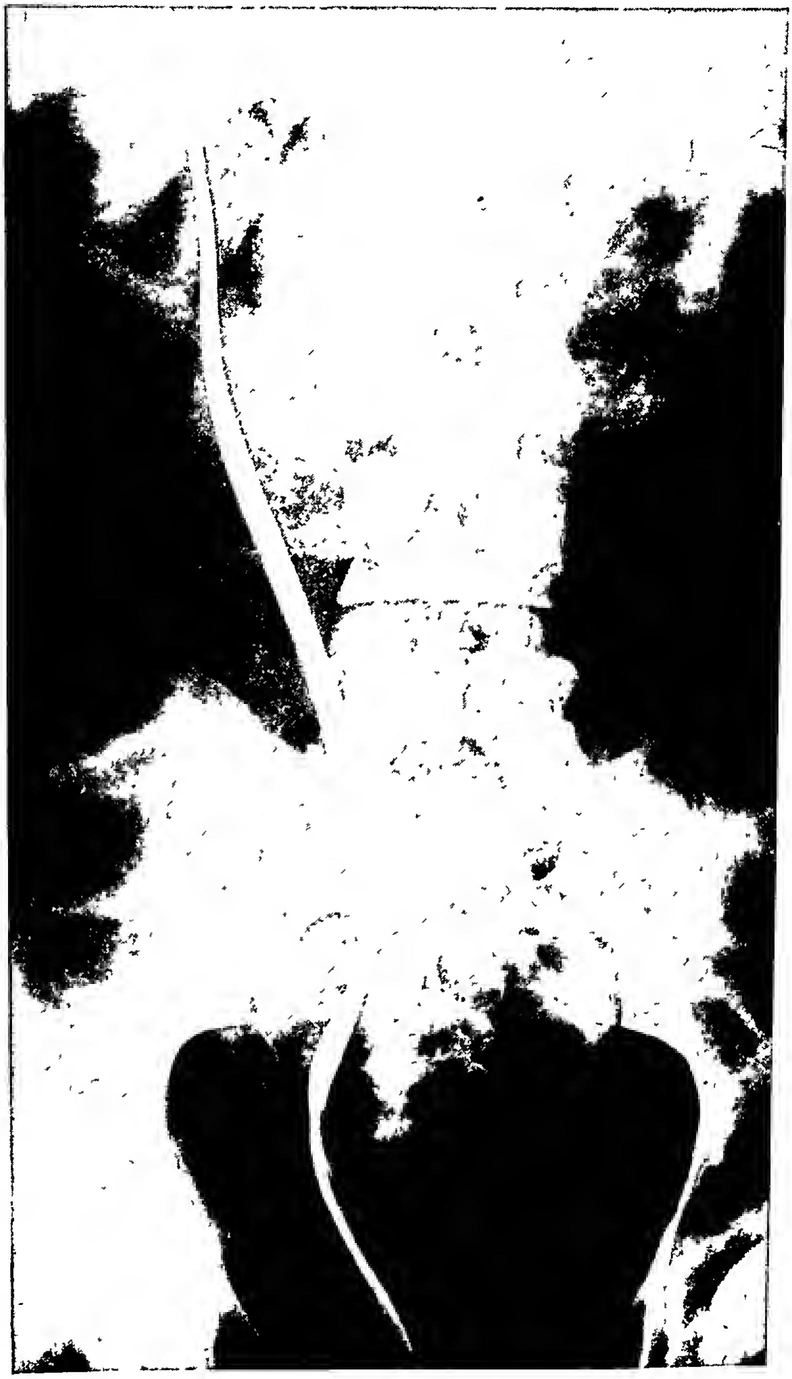

Fig. 291.—Stone in right ureter surrounded by three ureteral catheters The stone was removed with the catheters.

before removing them; Alyca uses spinal anesthesia. When the catheters cannot be removed without too great force, Alyca advises continuous elastic traction. This method has been successful in my own practice; the stone comes away in

relaxing medication It is rarely advisable to make more than two or three attempts at cystoscopic removal If the patient tolerates instrumentation well and there is no interference with drainage or impairment of renal function, fur

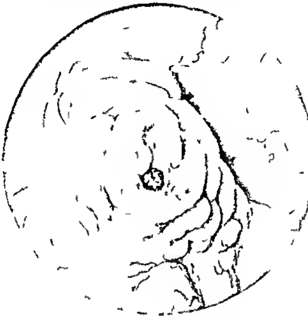

Fig 294 —Stone impacted at ureteral orifice

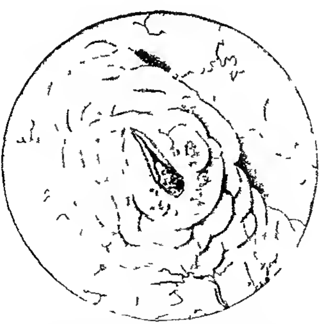

Fig 295 —Ureteral orifice incised to release stone

ther efforts may be made The experienced cystoscopist usually can evaluate the possibilities of success at the initial examination The temperament of the pa tient the ease with which the ureter can be dilated, and the size and contour

the table. Those most generally used are Howard's spiral stone dislodger (Fig 293) and those constructed with a wire cage for entrapping the stone. The majority of such instruments are rarely used and most writers express their preference for the multiple catheter method. Following the use of stone extractors, the kidney pelvis should be drained a few hours by a ureteral catheter. If the stone has been extracted, reaction following the trauma may partly occlude, with resulting pain and danger of infection. If the stone remains, there is almost certain to be immediate occlusion of the ureter, and because of the reaction from trauma there is little chance that it will pass immediately. A catheter left in place not only protects the kidney but causes further dilatation of the ureter and permits the introduction of relaxing medication that may aid in passage of the stone when the catheter is withdrawn.

Not infrequently a stone will pass the length of the ureter to become impacted just above the ureteral orifice It can often be seen bulging into the bladder A ureteral meatotomy either with scissors or a cutting electrode is

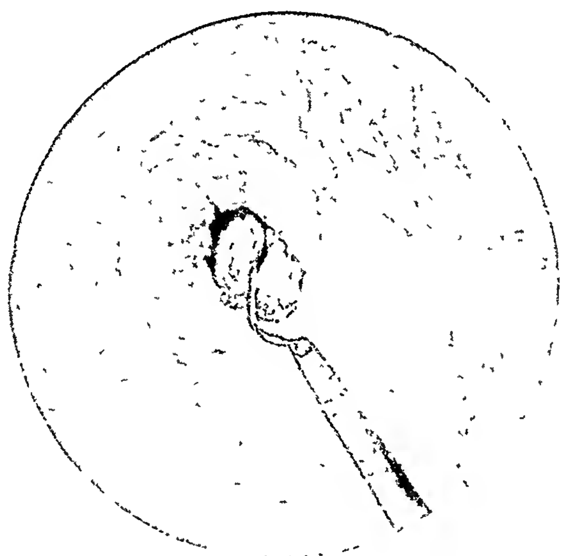

Fig 293 —Stone removed from lower ureter by corkscrew stone extractor

often necessary to deliver it into the bladder (Figs. 294 and 295). A meatotomy is at times necessary before the ureter can be adequately dilated for the removal of a stone higher up in the ureter. Fulguration of the ureteral orifice often seems to cause the downward progress of stones some distance from the orifice This is doubtless caused by dilatation of the ureter as a result of temporary partial occlusion of the ureter from edema following the fulguration. It is useless to attempt instrumentation of the ureter for several days following fulguration. The time to elapse between cystoscopic efforts to remove ureteral calculi and the number of such treatments before resorting to open surgery vary with each case. If there is evidence of adequate drainage, the procedure should not be repeated until the ureter has completely recovered from the preceding treatment, usually an interval of at least a week If there is evidence of obstruction, catheters should be re-introduced immediately if drainage cannot be obtained by

by fine sutures of chromic catgut placed only through the fibrous and muscular coats of the ureter (Fig 297) A soft rubber tissue drain is placed down to the ureter just below the ureterotomy wound Leakage is infrequent if there is no obstruction below the wound If the wound leaks after a few days, the urine will escape along the drainage tract Partial healing of the retroperitoneal space will prevent absorption of the urine Infection occurs to some extent in spite of drainage when urine is permitted to pour into a fresh, dependent wound

Fig 296 —Ureterotomy for removal of stone

Fig 297 —Closure of wound in ureter

URETEROSTOMY

When the kidney is infected and the ureter is dilated above the stone, the kidney is usually drained for a few days by inserting a small catheter, No 12 or 14 French, through a short incision in the ureter well above the wound made for removing the stone (Fig 298) The tip of the catheter should enter the kidney pelvis If the stone is impacted near the renal pelvis, the catheter may be inserted through an opening below the wound made for removing the stone I prefer to make a separate ureteral incision for drainage because of the inflammatory reaction around the site of an impacted stone Healing is hastened if the area can be placed completely at rest

of the stone are the most important factors. The surgeon should be prepared always to expose the ureter and remove the stone in the event of severe infection, anuria, or impassable occlusion of the ureter.

URETEROTOMY

Ureterotomy is rarely necessary except for the removal of stone and occasionally a foreign body. The ureter is exposed by one of the incisions previously described, pages 360-375, depending upon the location of the stone In the upper third of its course the ureter is found in the depth of the wound lying on the psoas muscle near its inner margin and in relation mesially with the ovarian or spermatic vessels. The lower two-thirds of the ureter is closely attached to the posterior surface of the peritoneum and is always on the posterior surface of this structure as it is reflected toward the midline of the abdomen. If the ureter is difficult to identify in this area, it may be readily found as it crosses the iliac vessels near their bifurcation and traced upward or downward to the stone Frequently the ureter can be promptly located by palpating the stone. When the ureter is brought into view the stone may be recognized as an area of thickening or increased vascularity of the ureter.

It is unnecessary to separate the ureter extensively from the peritoneum but it should be freed sufficiently to permit the ureter to be encircled with a narrow tape or a piece of catgut above the stone for the purpose of stabilizing the ureter and to prevent the stone from slipping upward out of reach. A Babcock or similar forceps is useful for this purpose. It is therefore desirable when practical to approach the ureter a little above the location of the stone. In long-standing cases retroperitoneal fat and cellular tissue may be matted together in the region of the stone. This should be carefully dissected away and the ureteral wall clearly exposed before it is incised. An ample longitudinal incision is made immediately over the stone In this way the stone can be cleanly delivered with less trauma and less probability of leaving fragments behind than when the ureter is opened above and the stone removed by dull curet or forceps. In most cases requiring ureterotomy the stone is securely impacted or adherent to the ureter (Fig 296). From a region difficult to approach I have succeeded in removing stones with a Howard spiral stone extractor passed through a ureterotomy wound several centimeters above the stone. When the stone is small and there is considerable thickening of the ureter, it may be difficult to determine the exact location of the stone. In such cases the ureter should be opened above the stone and a catheter passed downward until obstruction is encountered, when a second incision is made and the stone is removed Before the ureter is opened, provision should be made by suction or by gauze packing to prevent the wound from being flooded with urine. In infected cases with dilatation of the ureter a small catheter may be placed through a separate opening in the ureter before the stone is removed.

When the stone has been removed the ureter should be examined by passing a large ureteral catheter in both directions to assure adequate drainage. Satisfactory results may be obtained without suturing the wound in the ureter and when closure is difficult it may be safely left open, but when possible without unduly prolonging the operation, the incision should be carefully closed

the ureteral segment above and that below the site of obstruction Furthermore, the peristaltic force of the dilated portion of the ureter is diminished or abolished This is not conducive to adequate ureteral drainage even after the obstruction has been removed, and ureterotomy may be followed by infection of the wound and ureteral fistula

The dilated ureter readily admits a urethral catheter of sufficient size to permit adequate drainage and irrigation of the kidney pelvis until infection is controlled and maximum improvement in kidney function has been obtained In cases of stone in the ureter the drainage tube may be inserted through the ureteral wound from which the stone has been removed or through an additional opening nearer the kidney When there is considerable inflammatory reaction at the site of the stone, it is desirable to open the ureter at a higher level for drainage, putting the more diseased area of the ureter at complete rest The tip of the catheter should be within the kidney pelvis Gordon S Foulds used the Kehr-Dever T tube to provide prolonged drainage of the ureter, and has reported excellent results in cases of impacted ureteral calculi, stricture of the ureter, and in one case of an acute exacerbation of chronic pyelonephritis when the patient would not tolerate ureteral catheter drainage

It is very probable that ureterostomy would be satisfactory in many cases in which nephrostomy is used It is a less time consuming and safer procedure than nephrostomy The ureter can be exposed just above the crest of the ilium under local anesthesia with very little pain and no shock It should be considered in cases of surgical occlusion of the ureter and in early urinary suppression from obstruction to tide the patient over until corrective surgical measures are safe

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Temporary diversion of the urine for the purpose of improving drainage is a well-established principle in urological surgery. It is used extensively in the treatment of prostatic hypertrophy and other obstructive lesions of the bladder, as a preliminary procedure in massive pyonephrosis, in the postoperative treatment of renal calculosis, and after plastic procedures on the kidney.

The ureteral catheter is often used for drainage of the kidney when acute pyelitis is complicated by obstruction. It is of greatest value in the treatment of

Fig. 298.—Drainage of dilated infected ureter following ureterotomy for impacted stone. Drainage tube is placed through an opening made in the dilated ureter above the area of impaction

pyelitis of pregnancy and in pyelitis complicated by small ureteral calculi or inflammatory occlusion of the ureter. Ureteral catheter drainage is also useful to prevent back pressure and to control infection during the manipulation treatment of ureteral calculi.

Cases of chronic ureteral obstruction with dilatation of the ureter and infection of the kidney require more prolonged drainage than is practical with ureteral catheters. In such cases there is considerable disparity in size between

the ureteral segment above and that below the site of obstruction Furthermore, the peristaltic force of the dilated portion of the ureter is diminished or abolished This is not conducive to adequate ureteral drainage even after the obstruction has been removed, and ureterotomy may be followed by infection of the wound and ureteral fistula

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CHAPTER XXII

INJURIES OF THE URETER AND THEIR TREATMENT

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The small size and the mobility of the ureter, in addition to its deep position, protect it from external violence and from many penetrating injuries. However, the ureter occasionally becomes the victim of modern urological instruments employed to attack ureteral pathology, and occasionally it is accidentally injured or ligated during urological surgery or surgery of the female sex organs. Any type of ureteral injury may be followed by complications at or above the site of injury. In addition, the effect upon the kidney above the injury requires consideration.

PHYSIOLOGICAL CONSIDERATIONS

Several interesting recorded facts about the ureter should be noted before specific ureteral injuries are discussed. In spite of allegations to the contrary, both Hinman and Keyes (1936) believe that the ureter may be stripped of its entering blood vessels for a considerable distance without resultant necrosis if there is no interference with the artery at either end of the ureter.

Primary atrophy of an uninfected kidney above a completely ligated ureter has been supposed in urological legends, but Hinman's (1935) experimental work in animals demonstrated that hydronephrotic atrophy invariably follows ureteral ligation unless for some reason the affected kidney does not excrete urine. Hinman also believes that hydronephrotic atrophy is the rule in man If complete obstruction in one ureter lasts for less than ten days and if there is no infection above the obstruction, the obstructed kidney will not permanently lose its function This fact appears to have been demonstrated frequently in patients with ureteral calculi Hinman feels, however, that if complete occlusion has existed for one month or longer and if the opposite kidney is normal, the affected kidney will not resume significant function even though the ureteral obstruction is removed. The idea of renal counterbalance explains this phenomenon.

Crushing of the ureter is believed to have a damaging effect on the ureteral wall even though a clamp has been in place only a short time. Fistula formation commonly follows crushing but not, as a rule, ligation of the ureter. Keyes (1936) stated that the clamped (crushed) ureter should be treated as though it had been divided, and the clamped portion resected.

Keyes also has interesting practical comments to make about incisions in the ureter. A longitudinal incision can be made in the ureter without fear of fistula if there is no trauma by sutures, because there is no interference with ureteral peristalsis. An accidental transverse incision, however, is likely to be followed by fistula, especially if the ureter is cut halfway through. A conservative attitude is justifiable in some ureteral fistulas, for spontaneous closures have been noted especially in cases of ureterovaginal fistulas. Although the peritoneum is tolerant to uninfected urine, peritonitis often occurs when urine continues to drain into the peritoneal cavity. Periureteral tissues do not tolerate urine well, and adequate drainage is imperative.

PENETRATING INJURIES

Injuries of the ureter caused by gunshot, shell fragment, or stab wound usually also involve other organs. Robinson et al. (1946) found that in 25 war injuries of the ureter, 23 patients had injuries of other organs.

The difficulty of diagnosis is emphasized in the same report. Only 7 of the 25 cases were diagnosed initially; the remaining cases were not recognized until evidence of a urinary fistula appeared. Other cases observed by Prather (1946) confirmed the difficulties of early diagnosis and the failure of intravenous urography to be of material aid in the diagnosis.

The changes in the kidney above a ureteral injury can be quite variable. In a few instances no evidence of hydroureter or hydronephrosis developed above the injury (Fig. 299), but other personally observed cases developed a pyonephrosis within three months of injury, presumably because of stricture formation and inflammatory reaction at the site of injury.

Early diagnosis in war injuries is difficult. Serious associated injuries must be taken care of. Pyelography cannot be used at forward stations, so that early urinary drainage from the wound or surgical demonstration of the injury at the operating table remain the main primary diagnostic aids. Cases suspected later because of fistula formation require cystoscopy and retrograde study in combination with intravenous urography for detailed demonstration of the lesion.

Treatment of ureteral injury caused by penetrating wounds naturally depends on the location of the laceration and the other necessary surgery in the same patient. Anastomosis appears to be the best treatment, if it is possible: anastomosis of the ureteral ends over a T tube or anastomosis over a ureteral catheter with diversion of the urine above the injury, if a ureteral catheter cannot be passed through the site of injury by cystoscopic means. In injuries close to the bladder, ureterovesical anastomosis may prove desirable. Should no anastomosis be possible or even when an anastomosis is performed, extraperitoneal drainage must be provided.

When ureteral injury is recognized late and there is an adequately draining urinary sinus for the moment, the problem requires careful study to determine if some plastic procedure is practical or whether nephrectomy will be necessary.

The results of attempted repair are variable, but each successful operation represents a kidney saved (Fig. 300). Prather and Robinson (1945) in a survey of patients returned to hospitals in the United States during the recent war obtained data in 45 cases of the penetrating type of ureteral injuries. Five per

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Fig 300 —Infected hydronephrosis with stone Ureter of opposite kidney was injured during hysterectomy and transplanted into bladder two years before this kidney was removed At the time of the ureteral transplantation the kidney illustrated here was apparently in good condition The ureter was probably traumatized at the time the opposite ureter was injured and illustrates the importance of conservative surgery in the treatment of injury of the ureter

cent had had nephrectomy overseas, 5 per cent had had end-to-end ureteral anastomosis, and 7 per cent had had reimplantation of the proximal ureter into the bladder. Many had been treated by periureteral drainage. Of those who had not had nephrectomy overseas only 9 per cent had a normal kidney (by pyelogram) above the injured ureter. Sixty-four per cent had evidence of ureteral stricture. In the above 45 cases, at least 38 per cent eventually required nephrectomy and 20 per cent more needed other types of surgery.

Fig 299.—Retrograde pyeloureterogram four months after penetrating war injury of lower right ureter There are distortion and indication of stricture but minimal dilatation above the site of injury Calcification lateral to the ureter is caused by fragments from injured bony pelvis (From Prather War Injuries of the Urinary Tract, J Urol, January, 1946.)

CYSTOSCOPIC INJURIES

The semiflexible ureteral instruments commonly used to extract ureteral calculi, and other semirigid ureteral gadgets account for most ureteral perforations. Ordinary ureteral catheters or bougies, when not manipulated gently enough, have also caused perforations Demonstration of the condition is by ureteropyelogram.

Complications are not always serious Many cases apparently show little or no febrile reaction and little pain—no doubt because of lack of significant extravasation and absence of urinary infection We recall seeing an x-ray of a ureteral catheter which had been passed through the ureteral wall into the peritoneal cavity without any bad effect.

Complete section of the ureter requires the same type of ureteral repair as accidental crushing of the ureter

Partial section of the ureter may heal spontaneously if the cut is longitudinal and if there is no obstruction distal to the accidental injury Repair of the ureteral opening with a fine atraumatic type of suture over an 8 or 10 F bougie or over a ureteral catheter temporarily placed in the ureteral cut is good practice Closure of the ureteral walls over the ureteral catheter until the final suture is ready to be tied will avoid accidentally occluding the ureter by the sutures Extraperitoneal drainage to the skin surface is needed

Complications Discovered During Postoperative Period—Bilateral ligation of the ureters with resulting anuria requires emergency treatment The complication is usually suspected because of pain in the costovertebral region and lack of urinary output, and the suspicion is confirmed when catheterization shows no urine in the bladder When these signs and symptoms are present, the next step is cystoscopy to demonstrate whether or not an obstructive anuria is present In most instances the ureters are obstructed within 2 inches of the bladder wall and all efforts to pass the obstruction with ureteral catheters fail

There is little chance of success by attacking the obstructed area surgically a day or so after a pelvic operation, especially if the obstruction is close to the bladder Because of the uncertain success of this attack and because of the urgent need of urinary output to prevent uremia and death, a bilateral nephrostomy is the logical relief measure Upon completion of this operation intravenous fluids will doubtless be needed to stimulate urinary excretion Frequent determinations of the nonprotein nitrogen in the blood will provide helpful information A continued rise for forty eight hours after nephrostomy is not unusual

If the crisis is passed successfully and absorbable sutures have been used during the pelvic operation, spontaneous correction of the ligated ureter may occur during the following two or three weeks, and cystoscopic attempts to re establish ureteral continuity are logical

When continued obstruction exists and the patient has recovered from emergency surgery, consideration must be given to correction of the ureteral obstruction Unless the original operator feels confident that he can locate the obstructed area by the original approach, the urologist faces a difficult problem An extraperitoneal approach through a Gibson type of incision (in view of the midline laparotomy scar) offers the best chance of success

Unilateral Ligation of the Ureter—When upper urinary tract infection is present, acute obstruction of the ureter causes immediate symptoms manifested by fever and renal pain This requires prompt investigation and treatment Immediate cystoscopy and ureteral calibration are in order to demonstrate, if present, the existence and level of the ureteral obstruction When the findings point to accidental ligation deep in the bony pelvis nephrostomy will provide the needed relief for the septic kidney Later, after the patient's condition has improved the ureteral obstruction can be evaluated and appropriate measures taken

Patients with a perforated ureter should remain in hospital until all danger of extravasation and abscess formation has passed, so that any septic process that might develop can be treated with prompt surgical drainage.

SURGICAL INJURIES

Accidental injuries of the ureter occur most frequently during operations on the uterus and pelvic adnexa. The ureter is most vulnerable in the region of the uterine artery, although pathology in the female sex organs may distort the normal relations of the ureter in its course through the bony pelvis It may be useful to recall the anatomy of structures in this region. Gray's *Anatomy* says, "In the female, the ureter forms, as it lies in relation to the wall of the pelvis, the posterior boundary of a shallow depression named the ovarian fossa, in which the ovary is situated. It then runs medialward and forward on the lateral aspect of the cervix and upper part of the vagina to reach the fundus of the bladder. In this part of its course it is accompanied for about 2.5 cm by the uterine artery which then crosses in front of the ureter and ascends between the two layers of the broad ligament The ureter is distant about 2 cm from the side of the cervix "

Three types of injury have occurred during pelvic operations. ligation, clamping or crushing, and incision or section. The injury can, of course, be either unilateral or bilateral. Some operators have ureteral catheters inserted preoperatively so that they may be palpated and avoided during difficult operations. In discussing experiences with 24 patients who acquired ureteral injury during pelvic surgery, Prentiss and Mullenix (1951) reported that 37 4 per cent were recognized at operation, 37.4 per cent were discovered during the postoperative period in hospital and 25 2 per cent became apparent only after leaving hospital.

Ureteral Accident Discovered During Pelvic Surgery.—If during surgery an accidental *ligation* of one or both ureters is discovered, the ligature must be removed without further damaging the ureter and without incurring hemorrhage. There is a possibility of stricture formation at the site of the ligature, but little probability of fistula.

If during surgery *accidental crushing of the ureter* in a hemostat or clamp is discovered, it is believed that fistula formation will very probably follow, even though the clamp may have been in place for less than ten minutes. In one reported case (Furniss—1915) the fistulas developed on the eighth and twentieth day. Lack of fistulous urine during the first few days after operation does not provide assurance that a fistula will not occur later when effects of pressure necrosis become manifest. For these reasons it is probably best to resect the crushed portion of the ureter. An end-to-end anastomosis of the ureter over a T tube or over a ureteral catheter with ureterostomy above the anastomosis, or transplantation of the proximal ureter to the bladder appears to be the best procedure. In either case extraperitoneal drainage to the skin surface must be provided.

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If the upper urinary tract above the ligated ureter is not infected, the symptoms mentioned by the patient may not be severe enough to arouse immediate suspicion of the complication. Furthermore, there is no emergency, since one uninfected but obstructed kidney can be tolerated for seven to ten days without permanent harm. Investigation of persistent discomfort or pain in the kidney area may be initiated with intravenous urograms. Cystoscopy and attempted retrograde study will be required for positive diagnosis. In this instance, when function of the opposite kidney is normal, a planned attack on the obstructed area within a period of ten days is indicated. Should the diagnosis be missed for a month or more, the chance of re-establishing significant renal function would be diminished, presumably because of hydronephrotic atrophy. It would therefore be necessary to evaluate all aspects to determine if some type of surgery is feasible, possibly nephrectomy.

Ureteral Fistula.—Evidence of urinary fistula through a surgical incision or into the vagina requires study by cystoscopy and urography to establish the source of the leakage. If the complication is discovered soon after operation and is producing intra-abdominal complications or inflammatory changes in the wound, diversion of the urine by means of nephrostomy may be required provided a ureteral catheter cannot be passed above the fistulous opening for constant drainage during the process of healing.

If nephrostomy is required, further study will be necessary to see if spontaneous healing of the traumatic fistula will occur, if continuity of the ureter can be aided by cystoscopic maneuvers, or whether surgery will be needed.

Ureteroureteral anastomosis as described by Higgins and Smith (1941) has proved satisfactory in their hands. This can be done if the affected ureter is not dilated. When successful, sacrifice of a kidney is avoided.

If the accident has taken place in the lowest portion of the ureter, anastomosis of the proximal portion of the ureter with the bladder should be considered. Tissue from the dome of the bladder has been used to reconstruct a segment of ureter when the site of injury is low, and the successful use of ileum as a substitute ureter has been reported by Rack (1953). According to the experimental studies of Rosenberg and Dahlen (1953), autogenous vein grafts are not suitable to form a segment of ureter Nephrectomy is not infrequently the surest method of cure when the uninvolved kidney is normal

Ureteral Injury During Urological Surgery.—Inflammatory reactions around the ureteropelvic juncture may produce changes in the ureter which lead to accidental section or damage during surgery. In conjunction with ureteral anastomosis or re-implantation of the distal ureter into the renal pelvis without tension, a splinting catheter and nephrostomy drainage are important factors in the success of the operation. Nephrectomy may be advisable if the opposite kidney is adequate to maintain total function.

The lower ureter often pursues an abnormal course in cases of large bladder diverticula. During diverticulectomy or resection of the bladder for tumor, it is occasionally necessary to re-implant the proximal ureter into the bladder, as described elsewhere in this book.

opposite end down the distal segment, permitting the excessive length of catheter to coil up in the bladder The end of the catheter is later picked up by cystoscopic forceps and pulled through the urethra This is preferable to passing the catheter to the site of operation with the cystoscope It requires less time and there is less probability of introducing infection If space permits, the ureteral catheter may be passed through a stab wound in the ureter an inch or more below the area of anastomosis Occasionally when injury of the ureter is discovered during an operation the passage of a catheter through the cystoscope will aid in locating the lower segment If the operation has been done transperitoneally, retroperitoneal drainage is provided and the peritoneum is carefully sutured over the ureter

Transureteroureteral Anastomasis

This operation has been done experimentally by N W Sharp and by J J Gilbride Charles C Higgins was the first to report a successful clinical case Since the publication of his report, Smith has anastomosed one ureter to the other in two patients with satisfactory results in both The operation naturally has a rather narrow field, but may serve a useful purpose when the divided ureter must be disposed of by other than end to end anastomosis or transplantation into the bladder In the cases reported by Higgins and Smith the opposite ureter was dilated which certainly favors the operation One would question the advisability of jeopardizing a perfectly normal kidney and ureter when nephrectomy with a normal kidney remaining is attended by such excellent results The operation reported by Higgins was done in the following manner Two ureteral catheters passed up the normal ureter With the patient in the Trendelenburg position, the abdomen is opened through a midline incision After the intestines are packed away, the ureter is identified as it passes over the brim of the pelvis An incision about 2 inches long is made in the posterior parietal peritoneum, bringing the ureter to be transplanted into direct view It is then freed from its bed down to within ½ inch of the bladder, doubly clamped, divided and ligated The proximal end is fully isolated for a distance of about 3 inches The other ureter is then identified and exposed at the site selected for the anastomosis by an incision in the posterior parietal peritoneum The two ureteral catheters are palpable within the ureter

By a curved clamp a tract is made behind the posterior parietal peritoneum from the bed of the severed ureter at the brim of the pelvis to the point in the region of the opposite ureter where the anastomosis is to be performed The mobilized end of the severed ureter is then brought through this passage by a clamp or a suture in its end caught in the clamp

A small longitudinal incision is made in the recipient ureter and one of the catheters is delivered through the opening This end of the catheter is passed up through the open end of the divided ureter to the kidney pelvis, acting as a splint The free end of the divided ureter is united to the side of the opposite ureter with interrupted sutures of triple 0 chromic catgut The incision in the posterior parietal peritoneum over the area of anastomosis is

CHAPTER XXIII

URETERAL ANASTOMOSES AND IMPLANTATIONS

URETEROURETEROSTOMY

This operation is indicated when the ureter has been severed with little or no loss of ureteral substance and at too high a level to permit satisfactory ureterocystostomy. Implantation of the ureter into the base of the bladder is preferable when it can be accomplished without tension. This is particularly true when the injury is not recognized at the time it occurs and operation must be done later for the relief of ureteral fistula. If the surgeon must dissect the divided ends of the ureter from extensive scar tissue and leave the reunited ureter surrounded by this tissue, even though it has been freely liberated, there is little chance of satisfactory results. Stricture of the ureter will almost certainly occur, with eventual destruction of the kidney.

Excision of a segment of the ureter with re-establishment of the channel by anastomosis is occasionally indicated. Hinman has improved the drainage in cases of megaloureter by removing redundant portions and reuniting the ureter by end-to-end suture Excision of an adherent ureteral kink with end-to-end union has been successfully accomplished in my own practice with relief of pain and improvement in the function of the kidney. The same treatment is indicated in some cases of dense ureteral strictures which cannot be dilated.

A number of methods for uniting the divided ureter have been devised These include end-to-end union; invagination of the end of one segment into the other, the anastomosis of one segment into the side of the other (end-to-side method), and lateral anastomosis. End-to-end ureterostomy is the simplest and most physiological procedure. The other methods require more ureteral length for approximation, are more apt to interfere with ureteral peristalsis, and may prove obstructive to the passage of ureteral catheters

The ureter may be approached through either of the incisions previously discussed, depending upon the location of the lesion. In immediate repair of injury the ureter is already exposed When operating for the relief of fistula in the pelvic ureter the transperitoneal approach is more satisfactory. Dense adhesions obliterate the retroperitoneal space at the site of the injury, making it impossible to expose the ureter without tearing into the peritoneum, and much time is required to close the peritoneum when the exposure is inadequate Bleeding may also be a troublesome feature and is more readily controlled with the better exposure obtained through the open abdomen.

The ureter should be sutured over an indwelling ureteral catheter. This serves as a splint to the ureter and drains the kidney until edema at the site of operation has subsided. The catheter may be introduced by passing the tip of the catheter through the upper segment to the kidney pelvis and the

opposite end down the distal segment, permitting the excessive length of catheter to coil up in the bladder The end of the catheter is later picked up by cystoscopic forceps and pulled through the urethra This is preferable to passing the catheter to the site of operation with the cystoscope It requires less time and there is less probability of introducing infection If space permits, the ureteral catheter may be passed through a stab wound in the ureter an inch or more below the area of anastomosis Occasionally when injury of the ureter is discovered during an operation the passage of a catheter through the cystoscope will aid in locating the lower segment If the operation has been done transperitoneally, retroperitoneal drainage is provided and the peritoneum is carefully sutured over the ureter

Transureteroureteral Anastomosis

This operation has been done experimentally by N W Sharp and by J J Gilbride Charles C Higgins was the first to report a successful clinical case Since the publication of his report, Smith has anastomosed one ureter to the other in two patients with satisfactory results in both The operation naturally has a rather narrow field, but may serve a useful purpose when the divided ureter must be disposed of by other than end to end anastomosis or transplantation into the bladder In the cases reported by Higgins and Smith the opposite ureter was dilated which certainly favors the operation One would question the advisability of jeopardizing a perfectly normal kidney and ureter when nephrectomy with a normal kidney remaining is attended by such excellent results The operation reported by Higgins was done in the following manner Two ureteral catheters passed up the normal ureter With the patient in the Trendelenburg position, the abdomen is opened through a mid line incision After the intestines are packed away, the ureter is identified as it passes over the brim of the pelvis An incision about 2 inches long is made in the posterior parietal peritoneum, bringing the ureter to be transplanted into direct view It is then freed from its bed down to within ½ inch of the bladder, doubly clamped, divided and ligated The proximal end is fully isolated for a distance of about 3 inches The other ureter is then identified and exposed at the site selected for the anastomosis by an incision in the posterior parietal peritoneum The two ureteral catheters are palpable within the ureter

By a curved clamp a tract is made behind the posterior parietal peritoneum from the bed of the severed ureter at the brim of the pelvis to the point in the region of the opposite ureter where the anastomosis is to be performed The mobilized end of the severed ureter is then brought through this passage by a clamp or a suture in its end caught in the clamp

A small longitudinal incision is made in the recipient ureter and one of the catheters is delivered through the opening This end of the catheter is passed up through the open end of the divided ureter to the kidney pelvis, acting as a splint The free end of the divided ureter is united to the side of the opposite ureter with interrupted sutures of triple 0 chromic catgut The incision in the posterior parietal peritoneum over the area of anastomosis is

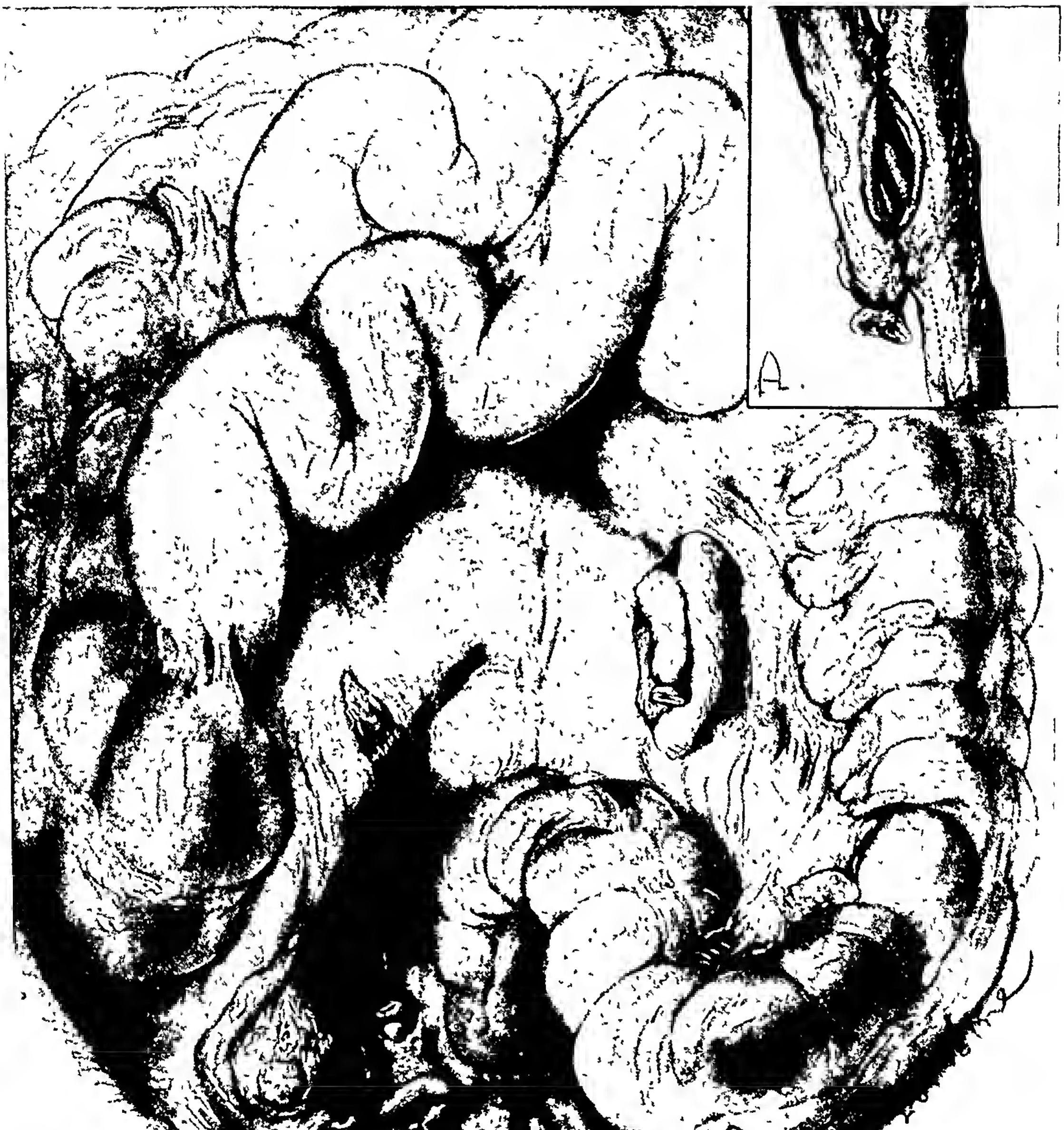

Fig 301—Showing transperitoneal exposure of the ureter The right ureter has been ligated and divided near the bladder The upper segment is carried beneath the peritoneum to the opposite side and anastomosed to the left ureter Insert (*A*) shows method of lateral anastomosis Higgins did an end-to-side anastomosis Two catheters are passed up the left ureter before operation One of these is brought out through the ureteroureterostomy opening and inserted in the right ureter to serve as a splint and drain the kidney.

then closed with interrupted sutures (Figs. 301 and 302). Drainage is established retroperitoneally by a strip of rubber dam through a stab incision in the abdominal wall to the region of the anastomosis. The abdomen is closed in the usual manner.

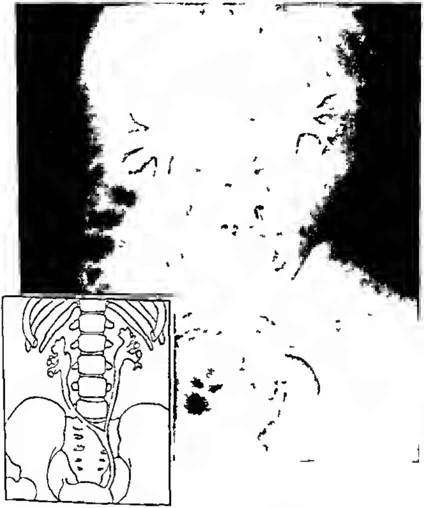

Fig. 302.—Pyelogram illustrating postoperative results following transureteroureteral anastomosis. (Smith, Lark C., and Smith, Dean J.: Ureteral Injuries and Their Management. Transactions American Association of Genito-Urinary Surgeons, 33: 175-183, 1940.)

URETEROCYSTOSTOMY

Ureterovesical anastomosis is the most desirable disposition of the ureter when it has been accidentally severed or must be divided because of disease. In resection of a portion of the bladder for malignant disease when the orifice of the ureter is involved, the ureter may be transplanted into the bladder with considerable assurance of a permanent preservation of the function of the kidney from which the ureter comes. The same is true when the ureter has been accidentally injured sufficiently near the bladder to permit the operation to be done without tension (Fig. 303). In cases of ureteral injury anastomosis

of the divided ends of the ureter should be reserved for those cases in which the proximal end cannot be implanted into the bladder. Ureterovesical anastomosis is also a useful procedure in the treatment of dense strictures near the ureteral orifice. In some cases of megaloureter with redundant loops in the pelvic area, drainage is improved by excising a segment near the bladder and transplanting the proximal stump into the bladder near the original orifice.

The technique of the operation will vary according to the problems to be met and to some extent according to the preference of the surgeon The ureter can be transplanted successfully either transperitoneally or retroperitoneally. In the transperitoneal operation the peritoneum should be accurately sutured over the ureter and extraperitoneal drainage should be provided to the area of

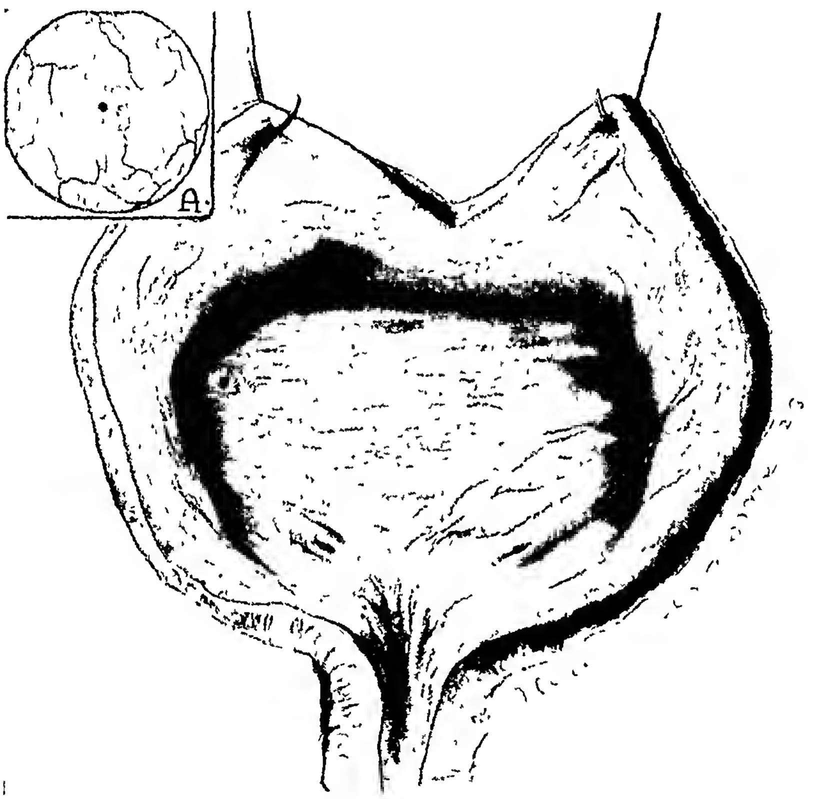

Fig 303 —Drawing to illustrate relation of new ureteral orifice to normal orifices Transplantation of right ureter to bladder two years before. Insert *A*, Cystoscopic view of new orifice

implantation. Transperitoneal implantation is the natural procedure when an injury of the ureter is discovered at the time of a pelvic operation. When operating to re-implant the ureter into the bladder because of disease or injury of the ureter or to re-implant the ureter following partial cystectomy, the extraperitoneal approach has several advantages. The ureter is more easily exposed and liberated. Both the ureter and the portion of the bladder presenting the most desirable location for re-implantation are normally extraperitoneal. Retroperitoneal drainage is more easily instituted and there is less danger of disastrous results from leakage or infection.

In all cases the cardinal principles of plastic surgery must prevail The structures must be approximated absolutely without tension Adequate blood supply must be preserved Infection must be prevented or controlled and the site of operation must be kept at rest The site of the implantation and the way in which the ureter is made to traverse the bladder wall depend to some extent upon the length of ureter available and in bladder resection upon the amount of bladder that must be removed The implantation should be made into the base of the bladder near the original ureteral orifice when possible Angulation at the point of entrance is less apt to occur and subsequent catheterization, if indicated, will be less difficult The ureter should only be implanted near the top of the bladder when it is necessary to prevent tension at the point of union I prefer a submucous implantation following the principles advocated by Coffey This should not be attempted, however, unless the ureter is long enough to project well into the bladder after traversing the wall obliquely

The additional length of ureter made available by mobilizing and straightening the ureter to lengthen it and lessen the distance that it must traverse to reach the bladder is considerable This is particularly true when the ureter has become dilated and tortuous because of partial obstruction, which often occurs following disease or fistula at the lower end of the ureter Furthermore, the ureter describes a considerable arc as it curves outward and backward along the surface of the true pelvis This arc can be straightened to a considerable extent without interfering with the physiology of the ureter The abundant blood supply and the free anastomosis of the ureteral blood vessels make it possible to free the ureter quite extensively without danger of necrosis The ureter is endangered only when the loose fibrous coat is stripped away I have found it necessary to ligate a small bleeding vessel at the end of the ureter before transplanting it when the ureter had been completely liberated well above the brim of the true pelvis

In my experience the following operation gives the most satisfactory results An incision is made beginning just above and about two inches medial to the anterior superior spine of the ilium and extending downward and inward parallel to Poupart's ligament It ends in the midline of the abdomen just above the pubis The aponeurosis of the external oblique is split throughout the length of the incision The internal oblique and transversalis muscles are divided in the direction of their fibers The fused aponeurosis of these muscles is then cut just external to the margin of the rectus down to the pubis This gives room for wide exposure of the retroperitoneal area The peritoneum is then separated from the posterior abdominal wall by blunt dissection from above the brim of the pelvis down to the bladder and medially to the spine As the peritoneum is retracted medially, the iliac vessels are exposed and the ureter can be seen as it passes over these vessels and can be traced along the posterior surface of the peritoneum until it enters the bladder or disappears into a mass of adhesions surrounding a ureteral fistula The ureter is freed from the peritoneum from well above the iliac vessels downward to the fistula or, in ureteral disease, to the bladder In the female, if the ovarian vessels interfere with liberation and exposure of the lower end of the ureter, they may be ligated and

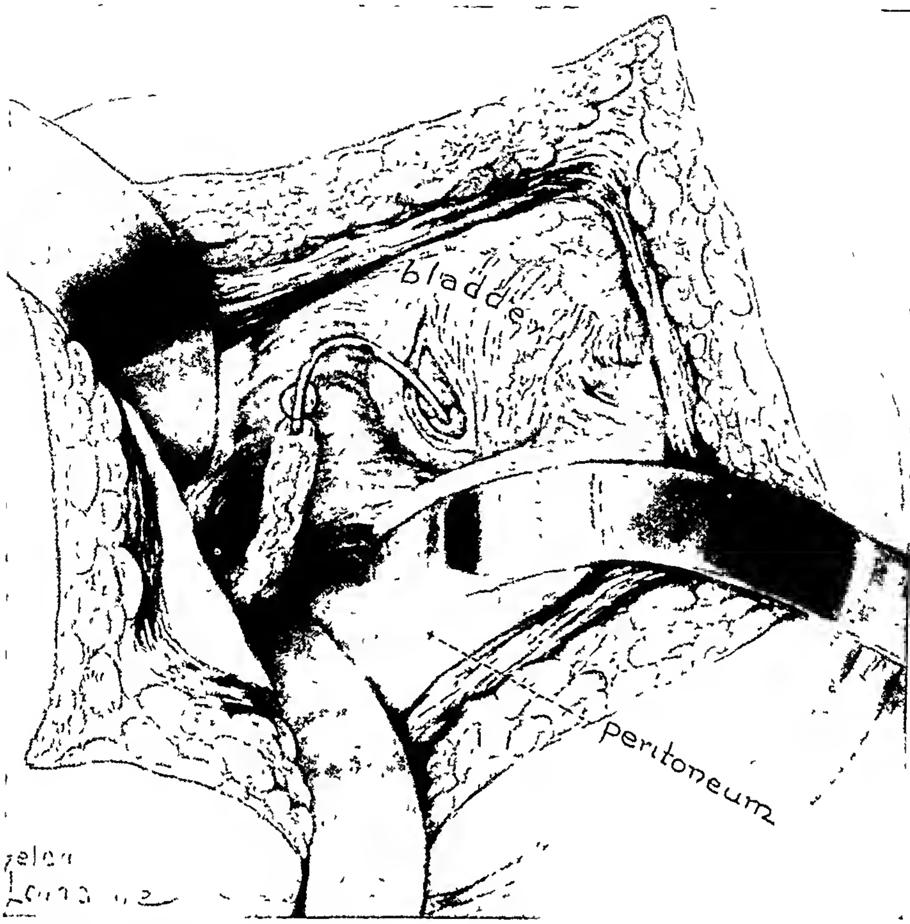

Fig. 304—Small catheter inserted a few inches into the ureter and secured by a ligature to the beveled end of the ureter serves as a splint (From Dodson Some Improvements in the Technique of Ureterocystostomy, J Urol, March, 1946)

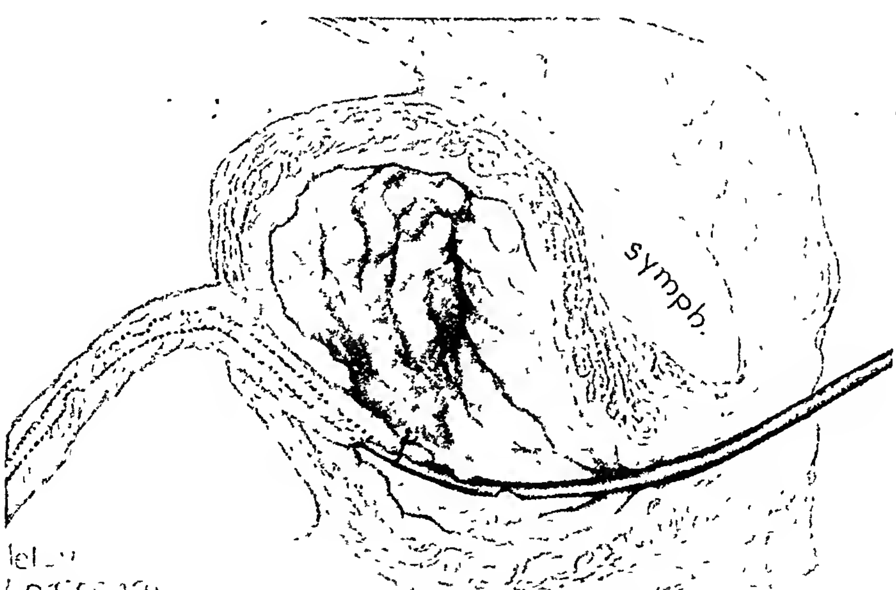

Fig 305—Ureter entering bladder beneath a mucosal flap simulating the normal. (From Dodson J. Urol, March, 1946)

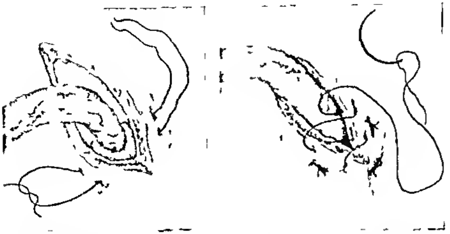

Fig. 06—Fixation sutures passed through superficial tissue of ureter and through the bladder wall secure the ureter in place (From Dodson J Urol March 1946)

Fig. 30 —The wall of the bladder is closed over the lower end of the ureter (From Dodson J Urol March 1946)

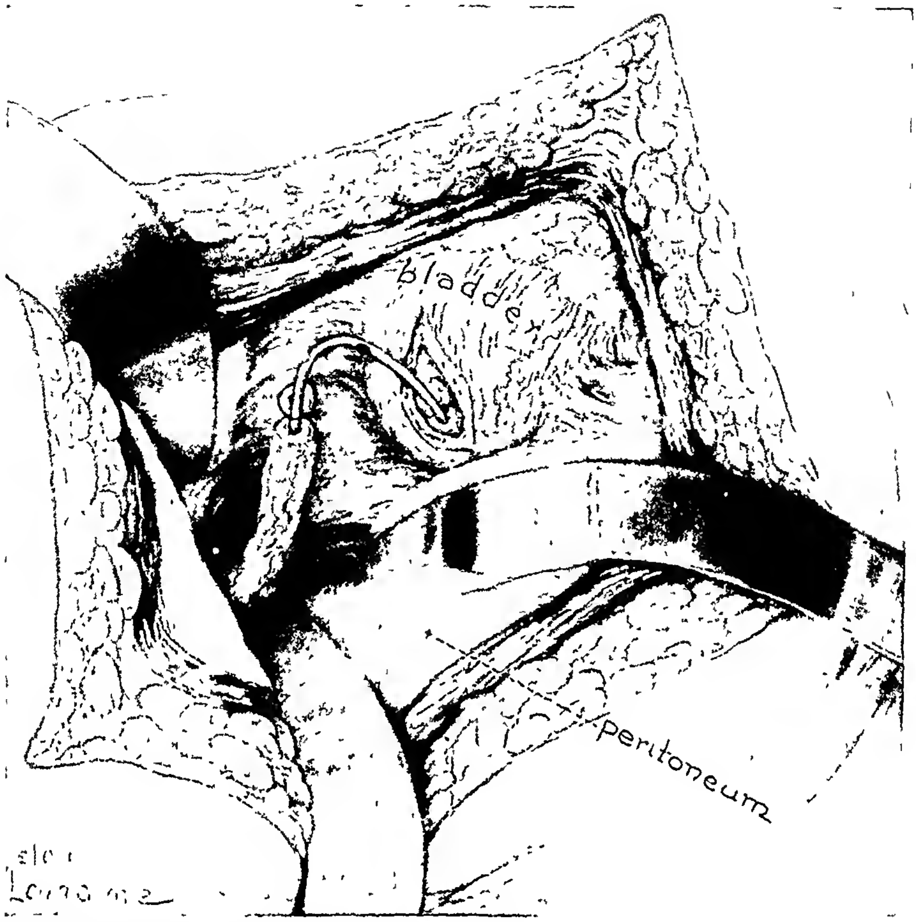

Fig. 304—Small catheter inserted a few inches into the ureter and secured by a ligature to the beveled end of the ureter serves as a splint (From Dodson Some Improvements in the Technique of Ureterocystostomy, J Urol, March, 1946)

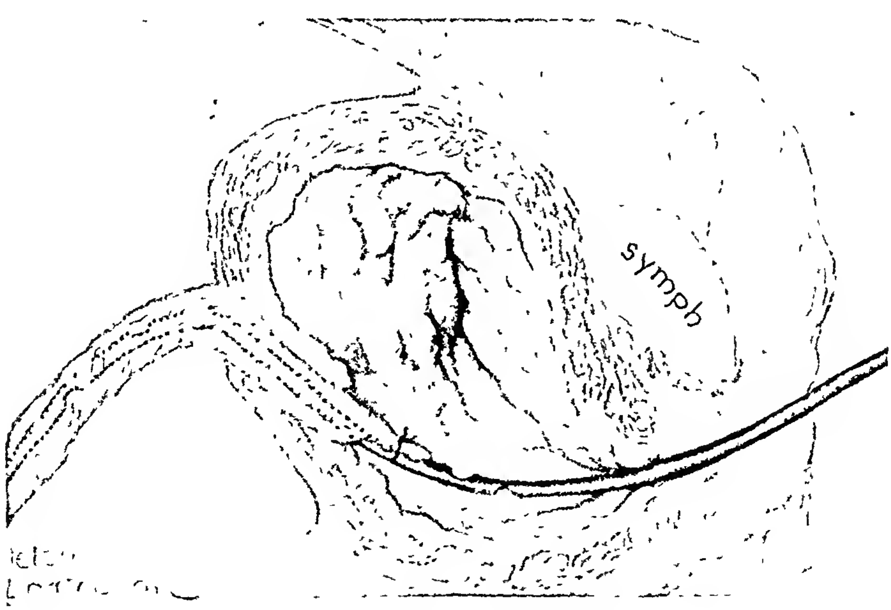

Fig 305—Ureter entering bladder beneath a mucosal flap simulating the normal (From Dodson, J. Urol, March, 1946)

has had the end cut off and two small holes made in the sides near the end, is inserted into the ureter for three or four inches A suture of 00 plain catgut is passed through the tip of the beveled ureter and tied snugly to the catheter (Fig 304) The catheter should not completely fill the lumen of the ureter Two more holes are made in the catheter just distal to the end of the ureter The distal end of this catheter is then sutured to the tip of the bladder catheter, which is withdrawn, pulling the end of the catheter in the ureter out through the urethra (Fig 305) Fixation sutures are taken through the superficial tissues of the ureter on each side about half an inch from the beveled tip Both

Fig 309—A method of transplanting the ureter A probe has been thrust through the bladder wall and the suture on the end of the prepared ureter is fastened to the tip of the probe

ends of these sutures are threaded on small curved needles The points of the needles are passed through the incision in the bladder and made to pierce the bladder wall from within outward As traction is made on the catheter, the ureter is pulled into the bladder until the area pierced by the sutures enters the bladder incision (Fig 306) The sutures are drawn taut and tied on the outside of the bladder as mattress sutures The muscle and fascia of the bladder are fastened over the ureter from below upward with a continuous suture of 0 chromic catgut (Fig 307) The last suture should catch a small piece of the

divided. The ureter is then divided just above the fistula or the diseased area. The lower stump is ligated or excised according to indications. In partial cystectomy including the ureteral orifice, the ureter is liberated and re-implanted following removal of the diseased bladder area. An incision is then made in the posterior wall of the bladder, extending from above downward about an inch long and as near the original ureteral entrance as possible (Fig. 304). The

Fig 308—Transplantation of ureter into bladder Mattress sutures taken in the two flaps of the divided end of the ureter are carried through the bladder wound out about one-half inch from the mucosal margins of the wound With these sutures the end of the ureter is drawn into the bladder The sutures are then tied The ureter is also fixed to the bladder by sutures of fine chromic catgut taken through the superficial tissues of the ureter and margin of the bladder wound If the operation is done transperitoneally, the peritoneum is sutured over the anastomosis

incision extends to, but not through, the mucosa, which is carefully dissected from the bladder muscles for a short distance on both sides of the incision. The mucous membrane of the bladder is then incised at the lower end of the incision, a thin-bladed hemostat is inserted into the bladder, and the end of a catheter, previously passed through the urethra, is grasped and pulled through the incision. The end of the ureter is beveled and a small soft rubber catheter, which

has had the end cut off and two small holes made in the sides near the end, is inserted into the ureter for three or four inches. A suture of 00 plain catgut is passed through the tip of the beveled ureter and tied snugly to the catheter (Fig 304). The catheter should not completely fill the lumen of the ureter. Two more holes are made in the catheter just distal to the end of the ureter. The distal end of this catheter is then sutured to the tip of the bladder catheter, which is withdrawn, pulling the end of the catheter in the ureter out through the urethra (Fig 305). Fixation sutures are taken through the superficial tissues of the ureter on each side about half an inch from the beveled tip. Both

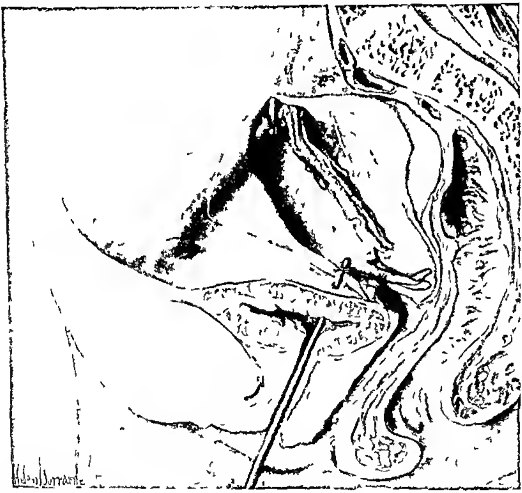

Fig 309 — A method of transplanting the ureter. A probe has been thrust through the bladder wall and the suture on the end of the prepared ureter is fastened to the tip of the probe

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superficial tissue of the ureter. A small rubber tissue drain is carried down to the implantation and brought out near the upper angle of the wound. A mushroom catheter is then inserted into the anterior bladder wall through a short incision and a purse string suture is placed around the catheter, making a water-tight closure. The catheter is brought out near the lower angle of the wound. With a small catheter in the urethra and the large catheter placed suprapubically, complete drainage and absolute immobilization are assured. When the length of the ureter does not permit a submucous implantation, the operation differs only in that the ureter enters the bladder through a short incision directly through the bladder wall.

The following method is also useful for direct ureterovesical anastomosis: A short incision is made through the bladder wall at the site selected for the anastomosis. The end of the ureter is split for about a quarter of an inch and sutures are taken through each of the flaps near the end. No. 0 chromic catgut on a moderate size curved needle is satisfactory. Both ends of each of these sutures are carried through the bladder wall from within outward as far from the margins of the wound as possible, one suture on one side of the bladder wound and the other on the opposite side (Fig. 308). When these sutures are tied on the external surface of the bladder, the end of the ureter is drawn into the bladder and anchored. The sheath of the ureter is then sutured to the margins of the bladder wound with interrupted sutures of fine chromic catgut. If the wound in the bladder is larger than necessary to accommodate the ureter, it should be closed around the ureter with interrupted sutures of chromic catgut. In no instance should the ureter be constricted A small rubber tissue drain is placed to the site of the anastomosis and brought out extraperitoneally. If the operation has been done through the peritoneum, the peritoneum should be securely sutured over the ureter before closing the abdomen.

When the ureter is considerably dilated or the re-implantation is done with the hope of relieving vesico-ureteral reflux, a cuff made by turning the distal half inch of ureter back upon itself has proved useful in our experience. A description has not been published, to my knowledge, but the operation has been used by Dr. Park Smith with considerable success. The ureter is exposed extraperitoneally and liberated, with care to preserve the adventitia and blood supply as much as possible Sufficient length of the ureter is allowed so that there will be approximately two centimeters projecting into the bladder A small skin hook is passed into the lumen of the ureter and the mucosa hooked about one centimeter from the end. Using the hook for traction, the distal centimeter of the ureter is rolled back and sutured in place with 0000 chromic catgut. The end of the ureter with its cuff is then brought obliquely through the bladder wall as near the normal site as possible. The edge of the cuff is carefully sutured to the margin of the mucous membrane of the wound in the bladder, thereby leaving a one-centimeter nipple covered by mucous membrane projecting into the bladder A few superficial sutures are taken externally to fix the surface of the ureter to the surface of the bladder. A splinting catheter may be used or not, according to the practice of the surgeon.

The following method was used successfully by J Shelton Horsley After mobilizing the ureter and cutting its end either obliquely or splitting it, a single mattress suture of linen is passed through the tip of the ureter and is left long A uterine probe is introduced through the urethra, either in man or woman, and the tip of the probe is pushed into the wall of the bladder at a point where there will be least tension between a transplanted ureter and the bladder wall A short stab incision is made over the point of the uterine probe and the long ends of the linen suture in the ureter are fixed in a loop knot around the end of the uterine probe (Fig 309) The probe is

Fig 310—The ureter has been drawn into the bladder by the method shown in the preceding illustration The peritoneum has been dissected so as to form a flap and completely envelops the ureter

then withdrawn, leaving the suture protruding from the external urethral meatus A catgut suture is passed through part of the wall of the ureter about one half inch from its end The linen tractor suture is pulled upon until the ureter is drawn into the bladder and the catgut suture is flush with the external surface of the bladder wall, when the catgut suture takes a bite in the bladder and is tied A similar suture is inserted on the opposite side of the ureter, catching only the muscular coat, and further fixes the ureter to the bladder wall Several other sutures are placed still further to invaginate the ureter If it is possible

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tion of the fibers of the external oblique to the semilunar line, is adequate for this purpose. After freeing and retracting the peritoneum medially, the ureter is exposed and liberated from below the bifurcation of the iliac vessels well up into the lumbar area. The ureter must be liberated sufficiently to permit it to be displaced laterally so that it will take almost a direct course from the kidney to the abdominal surface and will be on the lateral abdominal wall as it approaches the surface of the abdomen. This position prevents pressure upon the ureter by the abdominal contents when the patient stands erect. While the ureter is being liberated and displaced laterally, care should be taken to preserve the ovarian or spermatic vessels as they cross the ureter in the lumbar area.

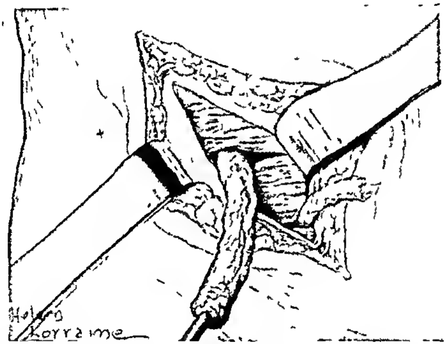

FIG. 311.—Cutaneous ureterostomy: the ureter is divided at a sufficient distance below the area of implantation to permit the end to protrude without tension well beyond the skin surface. A drain to the retroperitoneal distal ureteral stump is brought out through a stab wound at the lower angle of the incision.

When the ureter has been liberated, it is ligated and divided above the ligature, leaving ample length to project about an inch beyond the skin without tension. The ureter should be brought through the abdominal wall diagonally to prevent kinking (Fig. 311). A small rubber tissue drain is then placed near the distal stump of the ureter and brought out through the lower angle of the wound. The sheath of the ureter is sutured to the skin margin with a silk suture and the wound is closed loosely about the ureter (Fig. 312). A rubber catheter with two or three holes, of a size that will pass into the ureter without friction, is introduced to the kidney pelvis and secured in place for drainage.

As the wound heals, the ureter projecting beyond the skin will slough away, leaving a rosette of pouting ureteral mucosa which will not become

to do so the ureter is best implanted into a portion of the bladder that is covered with peritoneum, or sometimes a strip of peritoneum can be left on the anterior surface of the ureter which will greatly facilitate the healing. Slight traction is made on the linen tractor suture to determine accurately the amount of tension that will be needed to keep the ureter in position. When this is established, the tractor suture is fastened to the vulva in the female (Fig 310) or attached to a thin rubber band and fastened to the leg of the male patient If too much traction is used the suture quickly cuts out and if too little is made there is not sufficient relief of whatever tension exists between the ureter and bladder at the point of junction. Therefore, it is important to determine this point when the anastomosis has been finished and before the wound is closed The dissected portion of the ureter is covered with a peritoneal flap (Fig. 310) or with the sigmoid A small piece of rubber dam is carried down to the site of the anastomosis to conduct away any urine if there is leakage. All sutures that involve the bladder mucosa should be of plain catgut and others in the bladder wall may be of fine tanned or chromic catgut. The tractor suture of linen will come away in five or six days and in this time union will be sufficiently firm for no leakage to occur, particularly if peritoneum can be utilized either on the anterior surface of the ureter or on the bladder wall. The bladder should be immobilized several days following ureterocystotomy either by indwelling catheter or suprapubic cystostomy

URETEROSTOMY, EXTERNAL

Transplantation of the Ureter to the Skin

When the bladder must be removed because of a malignant growth, or when its presence as a functioning organ has become intolerable because of pain, it is necessary to dispose of ureteral drainage elsewhere. The same is true when the lower end of the ureter is being occluded by cancer or tuberculous infiltration Ureteroenterostomy is the most satisfactory method of disposing of the urine when the bladder must be dispensed with, provided the ureters are relatively normal. Unfortunately, in many cases in which the urine must be diverted from the bladder, the ureters are dilated by back pressure or thickened by inflammatory infiltration, which greatly increases the hazard of ureterointestinal anastomosis. It is in this group of cases that cutaneous ureterostomy is clearly indicated. It is also the preferred method of urinary diversion when the patient's life expectancy is too uncertain to risk the hazards of a more extensive operation.

Operative Technique.—The most satisfactory location for cutaneous ureterostomy is the anterior abdominal wall just below and about an inch medial to the anterior superior spine of the ilium The ureter can be brought to this area with ease, and in nearly a direct line without materially interfering with its blood supply. The anterior abdominal surface is more accessible to the patient, who in most cases must be responsible for the care of the ureteral orifice and the proper adjustment of the drainage tubes. The incision suggested for exposure of the middle third of the ureter, beginning just above and internal to the anterior superior spine of the ilium and following the direc-

in its new bed, sutures are removed from the lower end of the wound The silk suture is pulled upon, identifying the lower end of the ureter, which is divided and ligated and the wound closed leaving a satisfactory stump of ureter pro

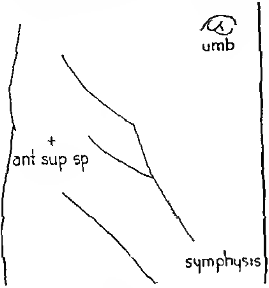

Fig 313

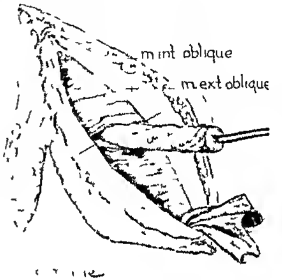

Fig 314

Fig 313 —Incision and outline of skin flap to be used to cover the protruding portion of the ureter
Fig 314 —Ureter protruding through deep abdominal muscles and dissected skin flap

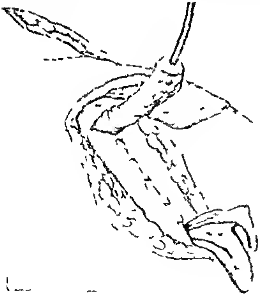

Fig 315

Fig 316

Fig 315 —Method of surrounding ureteral stump with skin flap
Fig 316 —Operation complete except few superficial sutures

truding In Goldstein's experience retraction and sloughing of the stump do not occur Heckel has suggested that these complications may be avoided by inverting the margins of the skin wound at the area from which the ureter

constricted. The most satisfactory method of maintaining drainage is by a urethral catheter which fits snugly in the ureter and is so adjusted that its tip rests just within the kidney pelvis. The catheter may be attached to a urinal which is strapped to the leg. The frequency with which the catheter must be changed varies with the individual case. When the urine is acid, catheters do not become encrusted and may be left in much longer, often a month or more without changing. When the urine is alkaline, the catheter must be changed more frequently. Irrigations and local medication can be carried out when necessary through the catheter. Very little, if any, leaking will occur when the catheter is properly adjusted. Most patients can be taught to care for ureterostomy, including changing and adjusting the tube. Appliances for collecting the urine without an indwelling catheter are rarely satisfactory

FIG. 312—Cutaneous ureterostomy. the ureter is fixed to the skin margin by an interrupted suture of fine chromic catgut Only the superficial tissue of the ureter is included in the suture

Difficulties have arisen following ureterocutaneous anastomosis because of sloughing, retraction, or stricture of the ureter. Goldstein has published an operation designed to overcome these difficulties. The operation is done in two stages. At the first operation, after making a lateral, muscle-splitting incision similar to the one described above, the ureter is thoroughly liberated down to or near the bladder but is not divided. A silk suture is placed through the adventitia of the ureter near the lower end and the ends are brought out near the lower end of the abdominal incision, to facilitate the second operation. A section of the ureter one or two inches in length is then brought up to the subcutaneous area and the muscles and deep fascia sutured beneath it, leaving a short section of intact ureter exposed. The skin incision is not sutured over this area of exposed ureter. A few days later when the ureter has become fixed

URETEROSIGMOIDOSTOMY

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For over one hundred years surgeons have been interested in the problem of uretero intestinal anastomosis The operation was performed as early as 1851 by Simon, and in 1892 Maydl reported the transplantation of the trigone, including the ureteral orifice, into the rectum extraperitoneally A year later Bergenhem reported transplantation of each ureteral orifice separately into the rectum extraperitoneally Although accompanied by high incidence of fistula formation and mortality, these operations met with some success

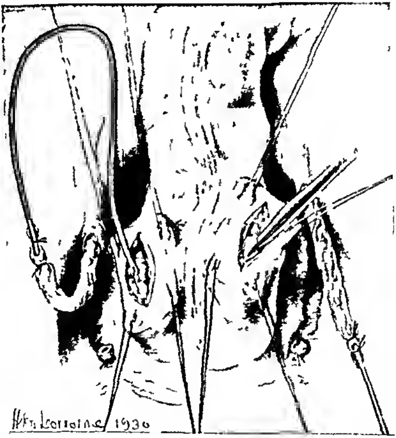

Fig 318 —This picture illustrates the Coffey No II method of ureteral transplantation The method has been discarded by most surgeons for the No I technique in which the ureters are implanted without catheters The incision in the bowel is the same except that the left ureter is usually implanted at a little higher level (See text)

The most noteworthy contribution was made by Robert C Coffey who emphasized the technique of forming a valve between the lower end of the ureter and the bowel Clinical cases successfully treated by his method were first reported by C H Mayo in 1911 and two years later by Coffey Coffey devised three methods of applying the valve principle in intestinal implantation of the ureters, which he designated techniques one, two, and three By

emerges. I have attempted to improve the standard operation by a plastic skin flap which is wrapped around the protruding end of the ureter, thereby protecting it and at the same time providing a nipple over which a drainage cup may be applied. The operation consists of two parallel incisions. The first begins about an inch medial to the anterior superior spine of the ilium and extends downward and inward almost to the margin of the rectus muscle. The second incision begins an inch or more above and an inch and a half medial to this and runs parallel to it. Just lateral to the margin of the rectus muscle, the incision is directed downward and slightly inward almost to the symphysis (Fig 313). The skin flap which is outlined by these incisions is dissected up. The ureter is brought out at the base of the flap (Fig. 314) The flap is then wrapped around the ureter and sutured in place by interrupted sutures of fine

Fig 317—Ureteral orifice three months following transplantation.

chromic catgut in the subcutaneous tissue and silk in the skin (Figs 315 and 316). The subcutaneous tissue of the skin is sutured to the adventitia of the ureter by two sutures of fine catgut. This operation was first done nine years ago because of an infected hydronephrosis following an unsuccessful uretero-enterostomy. The patient has remained well and works daily in a department store. She wears a drainage cup during the day and inserts a small catheter at night. The accompanying photograph is of a Negro boy whose only kidney has been damaged because of lower ureteral constriction (Fig 317). This procedure has the advantage that even should some sloughing or contraction occur the orifice would still be above the normal skin level. This, however, has not occurred in my patients.

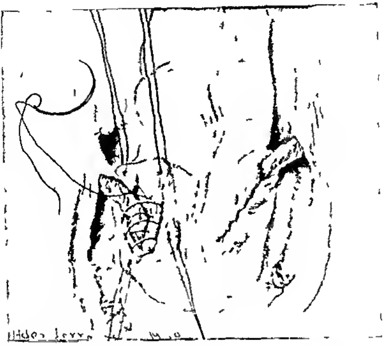

Fig 319.—The ureters lying on the mucous membrane of the bowel are covered by the muscular and peritoneal layers which are sutured with continuous or interrupted sutures of 000 plain catgut

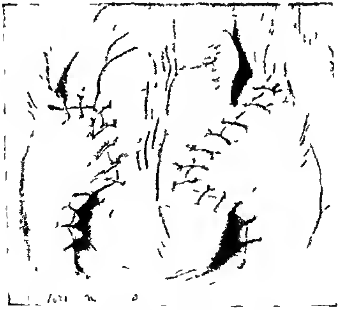

Fig 320.—The completed operation Flaps of parietal peritoneum from the margin of the wound made to expose the ureters have been sutured to the bowel entirely covering the wounds in the bowel and extraperitonealizing the area of transplantation

the first technique each ureter was transplanted in separate stages. In the second method, both ureters are implanted at the same operation, with ureteral catheters tied in the ureters to ensure immediate drainage of urine. In the third procedure the ends of the ureters are ligated and buried within the wall of the bowel with a necrosing suture of linen, including a bite of the ureteral wall into the lumen, and of the adjacent intestinal mucosa. This suture is tied tightly to produce a fistula from the ureter into the bowel.

A number of other techniques have been introduced since Coffey's work, the most noteworthy being direct anastomosis of ureter and bowel as advocated by Nesbit in 1949 and Cordonnier in 1949, and a combination of the Coffey and Nesbit techniques as described by Leadbetter in 1951.

Preparation for Surgery

Every patient is given a thorough physical examination in addition to routine laboratory tests of the urine and blood. Determinations of renal function by blood chemistry and dye estimations are complemented by intravenous urography and/or retrograde pyelograms. These latter studies are important in order to demonstrate any congenital deformities of kidneys or ureters and to indicate the degree of dilatation of the upper urinary tract, should such exist. Any existing anemia or evidence of poor nutrition should be corrected by appropriate therapy prior to surgery.

Preparation of the bowel requires four days Saline enemas are given daily, including the morning of operation A low-residue, high-protein diet is given until the day prior to surgery, when the patient is given a full liquid diet Magnesium sulfate, 15 c c. daily, is administered for two days prior to operation, and the bacterial count of the large bowel is rendered as low as possible by Aureomycin or Terramycin, 250 mg., four times daily for four days. A Levin tube should be passed into the stomach prior to operation and left in place for drainage postoperatively until normal peristalsis has returned and all signs of abdominal distention have disappeared.

Operative Technique

The anesthesia is either spinal or Pentothal Sodium induction followed by gas. With the patient lying on his back in the head-low position, a midline incision is made from the symphysis to the umbilicus; in obese patients it is carried 2 inches upward and to the left of the umbilicus. After the opening of the peritoneum and the placing of a self-retaining retractor, the intestines are displaced into the upper abdomen from right to left and maintained by moist packs held beneath Deaver type retractors The rectum and rectal sigmoid remain exposed. The right ureter can usually be seen crossing the iliac vessels, and the retroperitoneum is opened from this point downward to the bladder. The ureter is elevated by Babcock encircling clamps and dissected from its bed downward to the bladder. Care is taken to maintain its blood supply. The ureter is then ligated at the bladder, severed above the ligature, and the proximal end brought upward. The ureteral stump requires no treatment. The displaced ureter is further freed and lengthened by retroperitoneal finger dissection

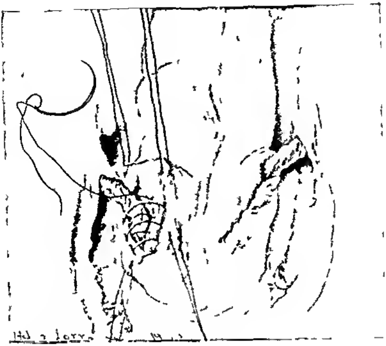

Fig 319 —The ureters lying on the mucous membrane of the bowel are covered by the muscular and peritoneal layers which are sutured with continuous or interrupted sutures of 000 plain catgut

Fig 320 —The completed operation Flaps of parietal peritoneum from the margin of the wound made to expose the ureters have been sutured to the bowel entirely covering the wounds in the bowel and extraperitonealizing the area of transplantation

Fig 321 —Master W S Intravenous urogram, fifteen-minute film, prior to transplantation of the ureters into the rectum

Fig 3-2 —Master W S Intravenous urogram fifteen minute film made one month following transplantation of the ureters

Fig 323 —Master W S Intravenous urogram, fifteen-minute film, two years after transplantation of the ureters Notice the approximate return to normal size of the renal pelvis

Fig 324—Master B G Intravenous urogram ten years following transplantation of ureters into the rectum

until it lies along the proposed rectal implantation site without tension. It is brought alongside the rectum by extending the upper angle of the retroperitoneal incision mesially or by bringing the ureter out through a counter incision A catheter may be passed up the ureter to determine its patency and to direct urine drainage during the preparation of the bowel. The retroperitoneal incision is closed by a continuous plain 0 catgut suture. The site of the incision into the rectum is preferably in a longitudinal band, and the area is made taut by four Babcock clamps.

As the bowel thus outlined is held drum-top taut, the incision may be readily made through serosa and muscularis without fear of incising through the mucosa. The scalpel is held like the bow of a violin, and the preferable blade is Bard-Parker No. 10 or its counterpart. The incision is 1½ to 2 inches in length and is separated from the mucosa laterally, sufficient for the ureter to lie in the trough thus created and be covered by serosa and muscularis without constriction. The ureter is now prepared by removing the catheter and incising its meatus longitudinally about 1 cm. An atraumatic No 1 chromic suture welded to the head of a J-shaped needle is passed through the tip of the ureter from the mucosa out and ligated by a square knot at the end of which the needle leads away from the ureter and the tail of the suture lies in the direction of the ureter. This latter portion of the suture is threaded up the lumen of the ureter to a point well above the area of proposed anastomosis, its purpose being to favor capillary drainage of urine into the bowel during the postoperative period of edema and possible obstruction The ureter is now laid in the prepared bowel trough without tension, allowing about 1 to 1¼ inch extension beyond the lower angle of the bowel incision. A series of interrupted 000 plain catgut sutures unites the serosa and muscularis over the ureter Care should be taken with the proximal stitch as this is the one most likely to constrict It should be placed well below the upper angle of the bowel incision, or the upper angle should be incised laterally to produce a nonconstricting flap. Bilateral guy sutures are placed through the outer layers at the lower bowel incision by separating these and making upward traction on the end of the ureter. The mucosa is made taut and elevated from the lumen of the rectum. It is punctured by a Bard-Parker blade No 11, the J needle is inserted through this perforation into the lumen of the rectum and brought out through the anterior bowel wall 1 to 1½ inch below. Traction on this suture draws the end of the ureter well into the bowel, and the guy sutures are ligated to complete the closure of the anastomosis The J needle and its exposed suture are wiped off with alcohol and the fixation stitch in the bowel wall completed Tabs of epiploica are tacked in place over the suture line and over the fixed (septic) suture.

The operation is completed by suturing the rectum to the ureteral exit opening in the retroperitoneum. If both ureters are to be transplanted, the left ureter is exposed, amputated and brought beneath the sigmoid to the right side of the bowel. It is anastomosed to the rectosigmoid and is somewhat above the right ureteral anastomosis. The abdomen is closed without drainage

In the Nesbit technique (Fig 325), the distal end of the ureter is split longitudinally for about 1 5 cm, producing a spatulate end to the ureter A longitudinal incision of equal length in the wall of the bowel permits an elliptical connection of ureter and bowel by using interrupted sutures of 0000 chromic catgut which penetrate all layers of both structures (Fig 325) This causes an inversion of the mucosal borders The anastomosis is extraperitonealized by suturing the lateral flap of parietal peritoneum to the bowel with interrupted sutures of 000 silk This operation has been widely used since its original description However, while the incidence of stricture formation is quite low the incidence of ureteral reflux is definitely higher than with the Coffey technique

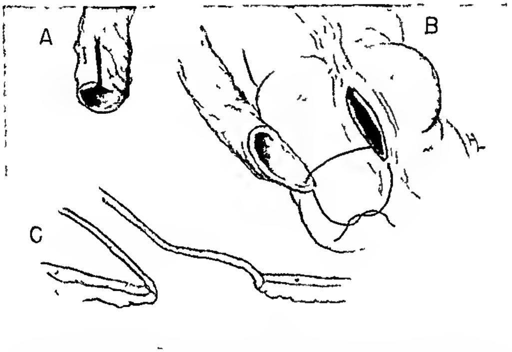

Fig 325—This figure illustrates Nesbit's technique for ureteral transplantation (A) The ureter is split longitudinally for 1 5 cm (B) The bowel wall is incised through the mucosa and the distal end of the ureter is sutured to the bowel with interrupted 0000 chromic catgut (C) The completed operation

For the past four years we have used the combined technique of Leadbetter, using a submucosal tunnel with mucosa to mucosa anastomosis (Fig 326) It has been our practice to place the ureters as low in the rectosigmoid as practical The end of the ureter is prepared as described by Nesbit (Fig 326) An incision, 2 5 cm in length, is then made slightly diagonally across the anterior taenia from the mesenteric margin of the bowel A trough is created in the bowel wall by incising the various layers down to the mucosa and gently stripping the mucosa from the overlying muscularis thus forming generous flaps on either side This allows the mucosa to invaginate into the bowel lumen easily, and after the ureter is placed in the trough the muscular flaps can be sutured over the ureter without compression or tension A short

opening is made through the mucosa at the distal end of the trough, and a direct anastomosis formed, using interrupted sutures of fine chromic catgut (Fig. 326). The muscular flaps of bowel wall are then sutured loosely over the ureter with interrupted fine silk sutures (Fig. 326) Reperitonealization of the anastomosis and fixation of the bowel are accomplished by suturing the lateral edge of the mesenteric peritoneum over the site of the anastomosis with fine silk sutures.

In 1951 Goodwin and Hudson published their modification of the Maydl-Bergenhem operations in which extraperitoneal transplantation of the divided trigone into the terminal rectum is performed. This procedure has been used by us in our cases of exstrophy with uniformly good results. As described by the authors, it has several advantages, namely· (1) extraperitoneal operation,

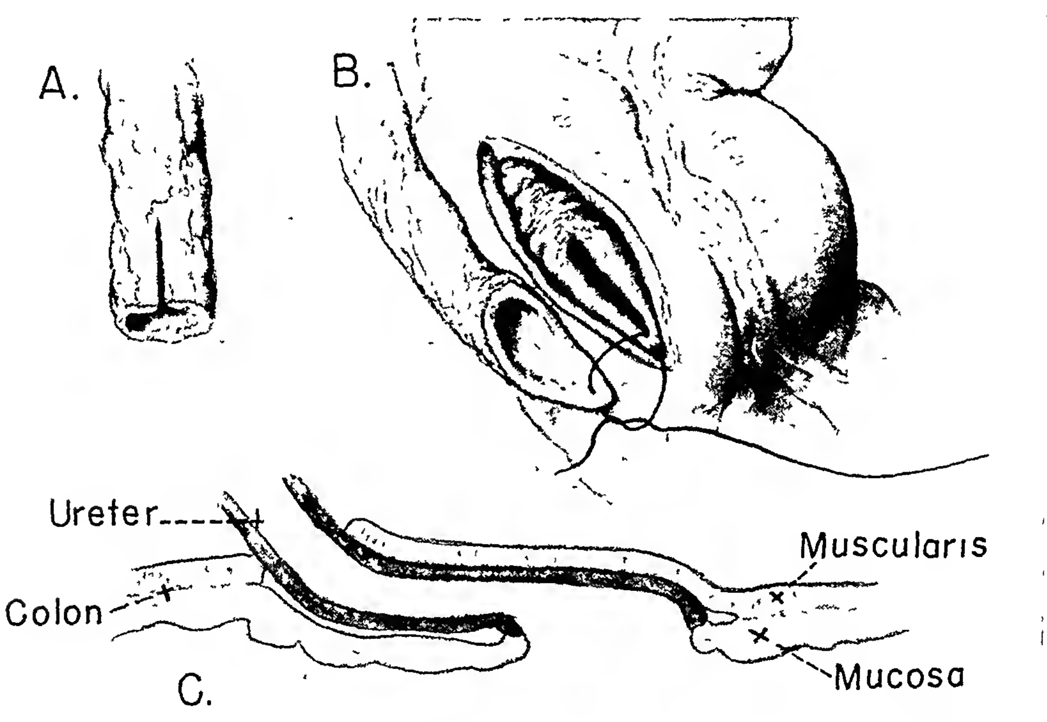

Fig 326—This figure illustrates the combined technique for ureteral transportation (*A*) The ureter is split longitudinally for 1 5 cm (*B*) The serosa and mucosa are incised, and the distal end of the ureter is sutured to the mucosa with through-and-through sutures of 0000 chromic catgut (*C*) The completed operation

(2) implantation of the intact ureteral orifice, (3) preservation of normal vascular and nerve supply to the orifice, (4) application of mucosa-to-mucosa principle, (5) low transplantation in the bowel, and (6) ureters entering the bowel in a nearly straight line.

Procedure.—Small ureteral catheters are inserted into the ureteral orifices and advanced several centimeters in order to later identify the orifices and intramural ureters The bladder is split longitudinally in the midline, with the incision extending through all layers of the bladder to the retro-

vesical plane of cleavage, anterior to the peritoneum (Fig 327) The bladder is next freed laterally and inferiorly by transverse incisions through the vesical neck *A small elliptical button of mucosa is prepared, with the ureteral orifice in the center, and the surrounding mucosa peeled away from the orifice by blunt dissection* (Fig 328) The bladder muscle is then incised at the periphery of the dissection The plane of cleavage between the intersymphyseal band and the rectum is developed by blunt dissection until the portion of the rectum 2½ to 3 cm inside the anal sphincter is brought into view Temporary stay sutures of silk are placed on either side of the proposed site of anastomosis in the rectal wall A vertical incision is then made

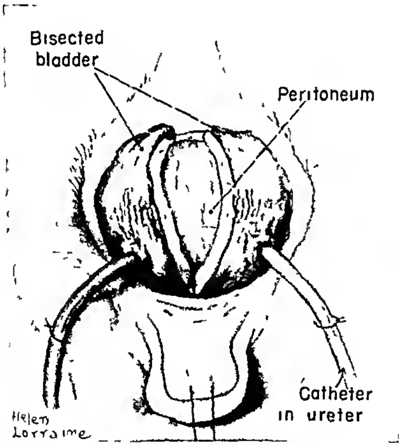

Fig 327 —The bladder is split longitudinally in the midline extending through all layers Ureteral catheters inserted into each ureter

through the rectogenital septum and the serosa and muscularis of the rectum to expose the mucosa (Fig 329) A small opening is next made in the mucosa and it is sutured to the mucosa surrounding the ureteral orifice with interrupted sutures of 00000 chromic catgut (Fig 330) Following this the muscularis of the bladder is anastomosed to the muscularis of the bowel with fine silk sutures (Fig 330) The procedure is repeated for the opposite ureter, and the remaining portions of bladder reapproximated over the area of anastomosis (Fig 331) The bladder is removed at a later date

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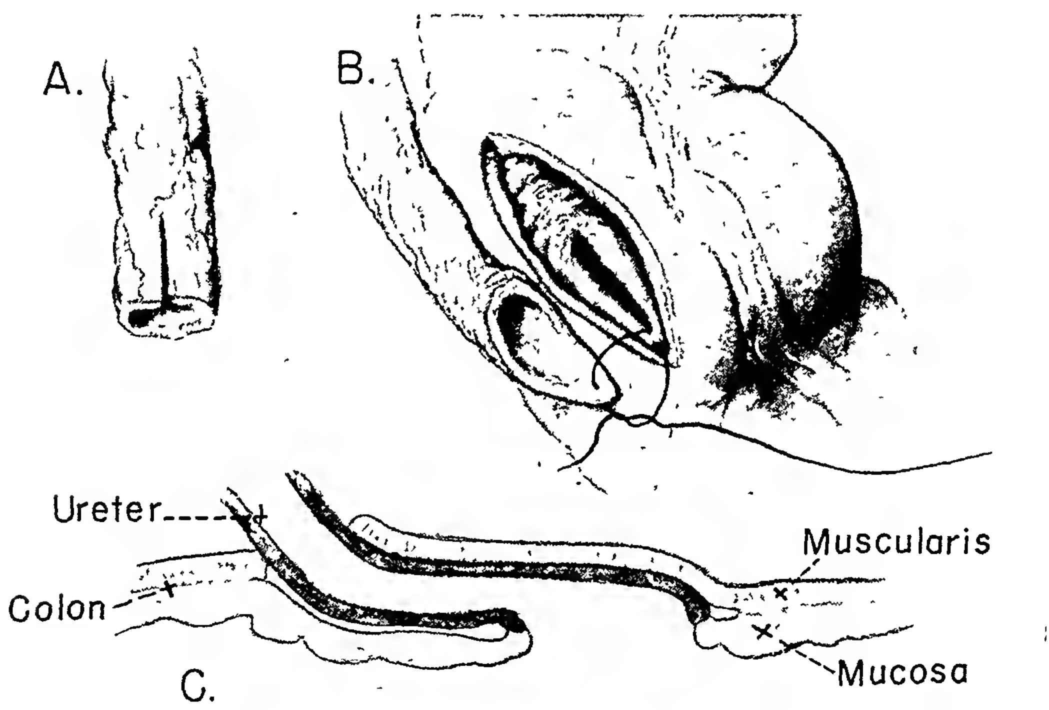

Fig 326.—This figure illustrates the combined technique for ureteral transportation (A) The ureter is split longitudinally for 1 5 cm (B) The serosa and mucosa are incised, and the distal end of the ureter is sutured to the mucosa with through-and-through sutures of 0000 chromic catgut (C) The completed operation

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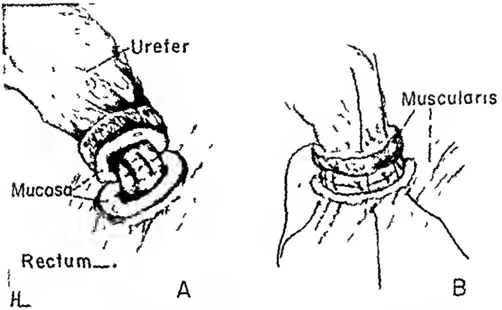

Fig 330 —(A) The mucosa of the rectum is sutured to the bladder mucosa surrounding the ureteral orifice with interrupted sutures of 0000 chromic catgut (B) The muscle layers of rectum and bladder are approximated with interrupted sutures of fine silk

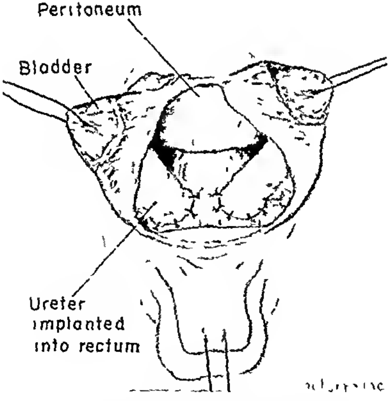

Fig 331 —The completed anastomosis The remaining portions of the bladder will be reapproximated over the area of the anastomosis

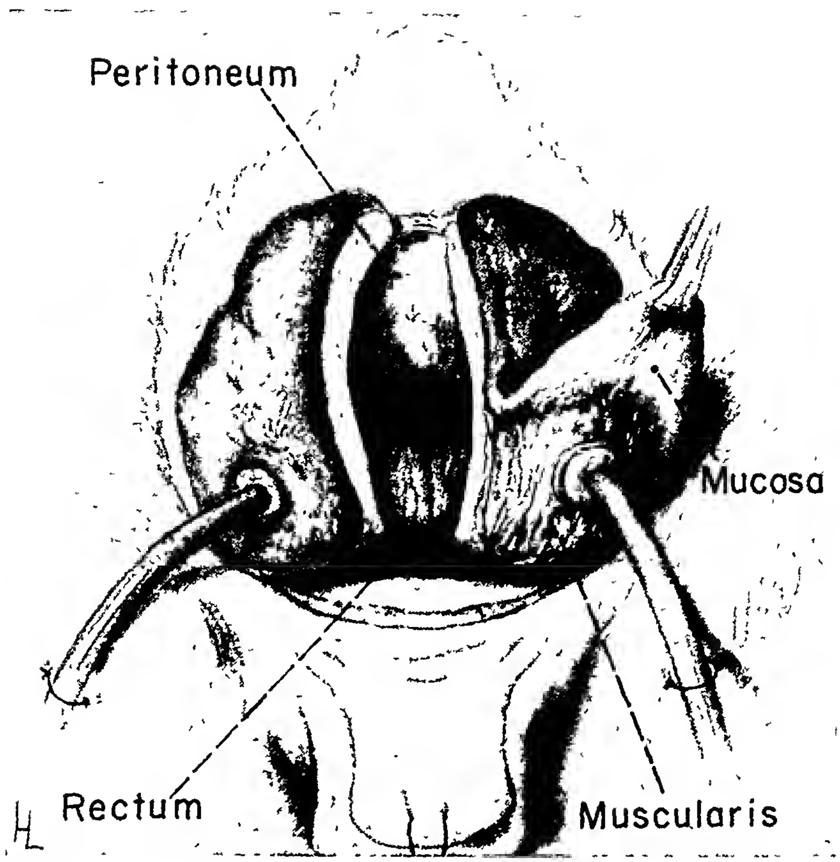

Fig 328—The bladder is freed laterally and inferiorly, and a small elliptical button of mucosa is prepared, with the ureteral orifice in the center

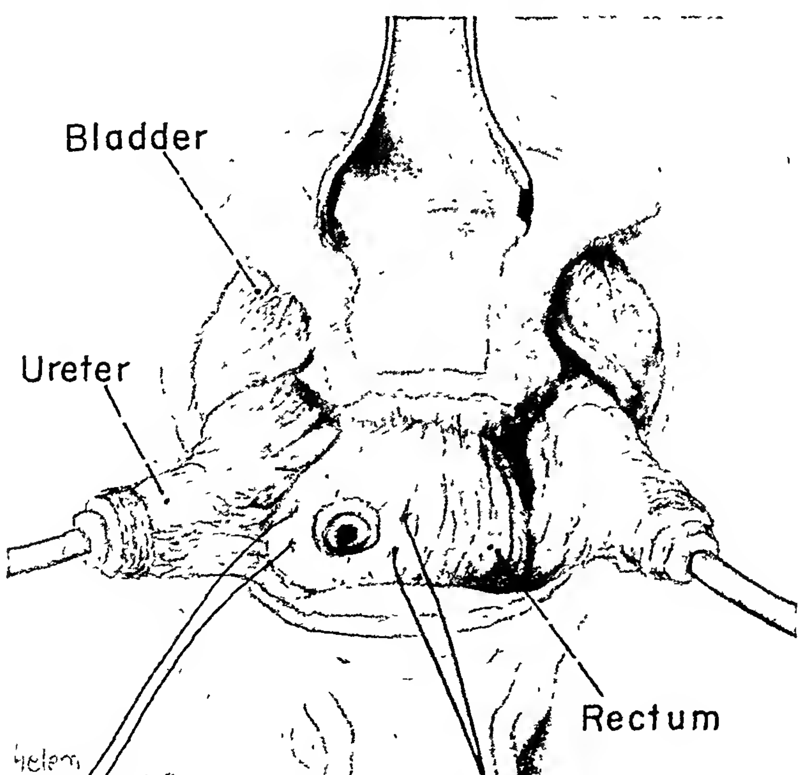

Fig 329—Incision is made into the rectal lumen through the rectogenital septum, the serosa, muscularis, and mucosa.

diet is frequently beneficial in reducing excretion of urea, chloride, and ammonia and in providing base in a palatable form. Additional base may be provided by 10 per cent sodium citrate in doses of 4 to 20 c.c. three to four times daily or Shohl's solution 15 c.c., four times daily. The more severe cases frequently need hospitalization with continuous drainage of the rectum with a rectal tube, blood transfusions, and intravenous electrolyte solutions.

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Postoperative Care

A soft rubber rectal tube is left in the rectum and connected to gravity drainage for 5 to 6 days postoperatively. This is generally irrigated with normal saline as often as necessary to keep the lumen free of fecal material. Terramycin or Achromycin is given intramuscularly for a few days until the patient can take the drug by mouth. Gastric suction is continued and the patient given nothing by mouth until active peristalsis is established. During this period parenteral fluids and blood are given as indicated by blood loss, urine output, and hydration. The patient is given fluids and diet as tolerated when active peristalsis has returned and all evidence of abdominal distention has ceased. Complete blood chemistry studies should be obtained frequently in the early postoperative period until it is certain that renal function is satisfactory.

Complications

The two most frequent complications following ureterosigmoid anastomosis are recurring episodes of pyelonephritis and disturbances in the acid-base balance

Mild episodes of pyelonephritis are usually accompanied by a low-grade fever, mild anorexia, increase in white blood cell count and, usually, a dull ache in the involved kidney region. The more extensive cases are generally associated with higher temperature, marked pain in the affected kidney, chills, nausea and vomiting, and anorexia. These cases generally will respond to bed rest, sedation, parenteral fluid administration and chemotherapy. Intravenous pyelograms should be done in these cases and surgical exploration carried out if there is any indication of serious renal impairment due to obstruction. Occasionally nephrostomy drainage can be a lifesaving procedure in such cases.

Exhaustive studies have been performed by numerous investigators on the causes for the acid-base imbalance which frequently follows ureterosigmoidostomy. However, the exact etiology and factors involved are still not completely understood A fairly large percentage of these patients will show evidence of imbalance, with varying degrees of azotemia, acidosis, and hyperchloremia Clinical manifestations of acid-base imbalance include weakness, anorexia, weight loss, diarrhea, irritability, nausea and vomiting, and confusion. It is believed that the following factors are responsible for the alterations which occur

1. Reabsorption of urinary chlorides, ammonia, urea, and acids by the bowel.
2. Obstruction and/or infection producing renal damage, thus rendering the kidney incapable of handling these excess waste products.

Treatment of patients with acid-base imbalance depends largely on the clinical and laboratory findings. The milder cases can usually be treated on an ambulatory basis. The rectum should be emptied at frequent intervals. Oral fluid intake should be at least 2,500 c c. daily. A low-salt, alkaline ash

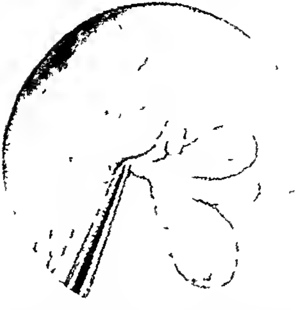

Fig 332.—Ureteral polyp protruding from left ureteral orifice. The tumor grew from a pedicle which was attached to the ureter two inches from the orifice. The growth had obstructed the ureter and the kidney was destroyed by hydronephrosis and infection. A ureteral catheter is inserted into the ureter.

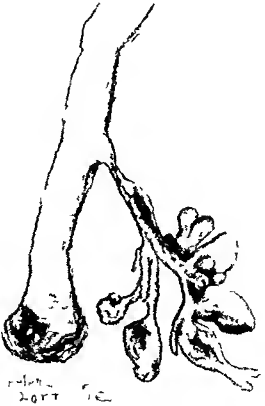

Fig 333.—Specimen polyp of ureter showing attachment. (See Fig 332.)

CHAPTER XXIV

TUMORS OF THE URETER AND THEIR TREATMENT URETERECTOMY

TUMORS OF THE URETER

Tumors of the ureter occur most frequently by extension, implantation or metastasis from other organs. The greatest number are secondary to papillary tumors of the renal pelvis. Tumors of the bladder, prostate, and female pelvic organs may involve the ureter by direct extension. Metastatic involvement of the ureter from carcinoma of the stomach, breast and lung has been reported. Primary tumors once considered extremely rare are now reported more frequently. They occur usually in the lower portion of the ureter.

Tumors of the ureter are of the squamous or transitional cell variety and may be benign or malignant. Papillomas or polyps comprise most of the benign tumors although fibrous growths of the ureter have been reported. Papillomas likewise comprise the majority of malignant ureteral tumors but in the primary group flat, infiltrating squamous and transitional cell carcinomas are encountered. Sarcoma of the ureter is extremely rare.

Hematuria and pain are the usual clinical manifestations. Hematuria may be intermittent or continuous, profuse or microscopic in amount. It is often the earliest and only symptom. In some cases bleeding is accompanied by colicky pain resulting from ureteral obstruction by blood clots. There may be constant dull pain and tenderness in the loin or along the course of the ureter. Most ureteral tumors obstruct the ureter and produce hydronephrosis which is often palpable. In late cases a mass can be palpated along the course of the ureter.

The diagnosis is made by cystoscopic and x-ray examinations. The appearance of bloody urine from a ureteral orifice always demands careful investigation of the kidney and ureter

Bleeding from the ureteral orifice, with clear urine obtained from the kidney pelvis, or the exaggeration of ureteral bleeding by catheterization of the ureter is strongly suggestive of ureteral tumor. In some cases the tumor can be seen projecting from the ureteral orifice (Figs. 332 and 333) Urographic evidence of ureteral tumors consists of filling defects in the ureterogram (Fig. 334) or localized changes in the contour of the ureter. In cases of transplantation or extension of the neoplasm from the kidney, the primary growth may be recognized by filling defects in the pyelogram.

Treatment.—The treatment of choice is removal of the kidney and ureter, including a small section of the bladder surrounding the ureteral orifice (Fig. 335). If the patient's condition will permit, the ureter and kidney should be

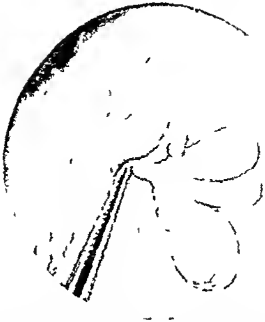

Fig 332.—Ureteral polyp protruding from left ureteral orifice. The tumor grew from a pedicle which was attached to the ureter two inches from the orifice. The growth had obstructed the ureter and the kidney was destroyed by hydronephrosis and infection. A ureteral catheter is inserted into the ureter.

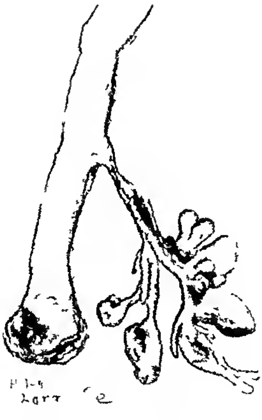

Fig 333.—Specimen polyp of ureter showing attachment. (See Fig 332.)

removed at the same time. When this is not practical, either the kidney or ureter may be removed first, depending upon the location of the primary tumor. Primary tumors of the ureter are usually located in the pelvic segment (Figs. 336, 337 and 338). This portion of the ureter may be removed and the kidney drained by a temporary ureterostomy until nephrectomy can be done. Permanent ureterostomy or nephrostomy with complete excision of the ureter may be indicated when the function of the opposite kidney is inadequate. I excised a carcinoma from the lower end of the ureter and transplanted the ureter into the bladder. The condition of the opposite kidney was questionable. There is no recurrence, after ten years

Fig 334 —Ureterogram showing filling defect from ureteral tumor opposite fifth lumbar vertebra Nephrectomy for papillary tumor of renal pelvis six months before

URETERECTOMY

Excision of the ureter is necessary in tumors of the kidney pelvis and usually in primary tumors of the ureter, and is desirable in pyogenic or tuberculous infection of the ureter when adequate drainage cannot be secured. The ureter can be removed at the time of nephrectomy or at a second operation. When the condition of the patient will permit, it is better to remove the kidney and ureter at the same time. Following nephrectomy it is occasionally necessary to

remove the ureter because of pain, irritation of the bladder or a persistent lumbar sinus W J Engel has reported the case of an aberrant ureter ending blindly which was removed because of frequent attacks of ureteral colic When the kidney and ureter are to be removed at the same time the kidney should be removed first unless the operation is for a primary tumor of the ureter After exposing the kidney, the ureter is freed as far downward as possible ligated and divided, and the cut surface is sterilized with phenol The kidney

Fig 335 —Technique of ureterectomy A cuff of the bladder surrounding the ureteral orifice has been removed and the bladder wound is being closed with interrupted sutures of No 1 chromic catgut

is removed and the wound closed The patient is then placed in the supine position and the remaining portion of the ureter is removed through a Gibson or a paramedian incision, or the ureter can be left attached to the kidney and removed as described under nephroureterectomy pages 335 336

When the operation is for tumor of the kidney pelvis or ureter, a small portion of the bladder wall should be removed with the terminal ureter

Fig 336 —Primary tumor of ureter Note defect in ureterogram near the bladder

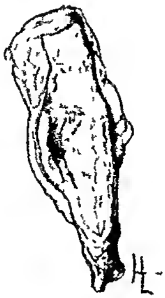

Fig 337 —Primary carcinoma of ureter (Ureterogram Fig 336)

Fig 338 —Photomicrograph (reduced from ×200) primary tumor of ureter (Figs 336 and 337)

When the ureter is soft and pliable it may be inverted into the bladder by the method suggested by McKenna. The lower end of the ureter is securely fastened to an inlying catheter. As the catheter is pulled upon, the ureter is invaginated into its lumen and turned inside out as it is gradually drawn into the bladder. Randall has reported the successful use of this method. In his case when the patient was turned upon his back for operation upon the ureter, about four inches of the ureter attached to the catheter was projecting from the urethral meatus. The bladder was opened, a deep mattress suture taken through the base of the ureter, and the ureter excised. Exploration showed the retrovesical space to be free of hemorrhage.

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CHAPTER XXV

SURGICAL APPROACH TO THE BLADDER INCISIONS FOR OPERATIONS ON THE BLADDER

Surgical Approach, Suprapubic Cystotomy and Cystostomy, Vaginal Cystotomy and Cystostomy, Perivesical Drainage

SURGICAL APPROACH TO THE BLADDER

The bladder is usually exposed for surgical operations through the supra pubic area of the anterior abdominal wall A median incision is made extending from the pubis upward for a sufficient distance to permit the necessary exposure The skin, the subcutaneous fat and fascia and the anterior sheath of the recti muscles are divided The recti muscles are separated in the midline The pyramidalis muscles which lie upon the recti muscles in the lower angle of the wound are likewise separated Just above the pubis a small amount of fat is found between the muscles and the transversalis fascia This fascia is divided and the prevesical space containing considerable fat and areolar tissue is exposed Beneath this is the vesical layer of pelvic fascia which is loosely attached to the surface of the bladder The bladder is readily recognized by the large veins which course in an irregular manner over its surface

The Pfannenstiel Incision —The transverse incision as described by Pfannenstiel provides a satisfactory approach to the bladder The incision, slightly convex superiorly, is placed at the pubic hairline and usually extends the width of the recti muscles but may be extended further when indicated After dividing the superficial structures and the anterior sheath of the recti, the anterior sheath is separated from the recti muscles for a short distance above and below the incision The recti muscles are then separated in the midline and retracted laterally, exposing the prevesical space (Fig 339) When more room is needed, the sheath may be separated from the recti muscles down to the pubic bones and the recti muscles separated from the pyramidalis and divided transversely at their pubic attachments The recti muscles then retract upward When this is done the recti muscles must be carefully sutured to the anterior sheath when the wound is closed

The Cherney Incision —The Cherney incision extends from just medial and inferior to either anterior superior spine of the ilium, crossing the abdomen just above the pubis, with its convexity directed downward The superficial epigastric vessels are exposed at either extremity of the incision and may be divided when necessary for better exposure

The sheaths of the recti muscles are divided in line with the skin incision and the aponeuroses of the oblique abdominal muscles are incised to the angle of the wound Near the angles of the wound muscle fibers of the internal oblique

are encountered and may be divided in the direction of the wound by blunt dissection. When the transversalis muscle is encountered, it may also be divided in the direction of its fibers This exposes the recti muscles in the midline and the transversalis fascia and underlying peritoneum laterally.

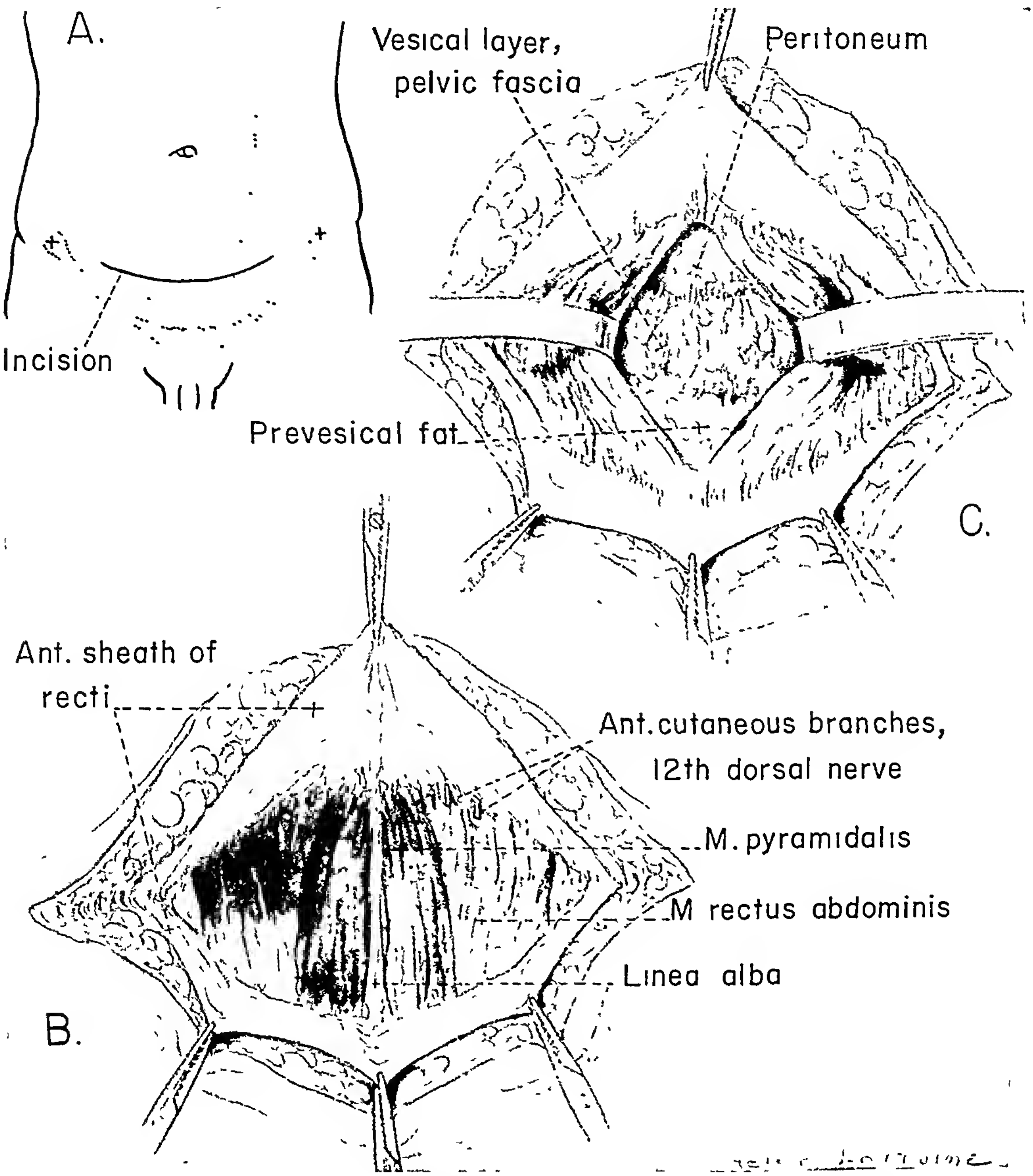

Fig 339.—The transverse (Pfannenstiel) incision for exposure of the bladder

The inferior flap of the rectus sheaths is then dissected from the recti muscles down to the symphysis pubis. The central fibrous septum which extends from the rectus sheaths to the recti is cut, and the pyramidalis muscles are freed from the recti. The inferior ends of the recti are then liberated from the under-

lying transversalis fascia and cut transversely, flush with the pubic bone The recti retract upward, giving wide exposure to the suprapubic area When the wound is closed, the tendinous ends of the recti are first sutured to the under surface of the lower flap of their sheaths at or near the symphysis

The Cherney incision gives excellent exposure of the bladder and terminal portion of the ureters In most patients, however, adequate exposure can be obtained without such an extensive incision

In the female the base of the bladder is readily accessible through the anterior vaginal wall A thin layer of connective tissue, the vesicovaginal septum, separates the two structures This approach is used most frequently for the repair of vesicovaginal fistulas Stones and foreign bodies in the female bladder may be removed through a vaginal cystotomy incision Tumors of the bladder when favorably situated may be removed through a vaginal approach and total excision of the bladder is more easily accomplished by a combined vaginal and suprapubic operation

The bladder is rarely operated upon through a perineal incision Stones are occasionally removed at the time of a perineal prostatectomy, and tumors involving the vesical orifice have been successfully removed through a perineal incision The anatomical structures involved in this exposure are discussed under operations upon the perineum

When the bladder is collapsed, the peritoneum extends to the pubic arch, but when it is distended, the pubovesical reflection of the peritoneum rises one to two inches above the pubis leaving ample space to expose the anterior surface of the bladder extraperitoneally The peritoneum is loosely attached to the bladder over the anterior surface and is easily stripped upward increasing the exposure to any extent desired In some operations upon the bladder it is necessary to open the peritoneum This does not add greatly to the operative hazard provided care is taken to prevent contamination of the peritoneal cavity

Operations Upon the Bladder—The bladder is operated upon for the purpose of establishing urinary drainage and for the removal or correction of pathological conditions not amenable to medicinal or instrumental methods of treatment

Drainage—Surgical drainage of the bladder may be either temporary or permanent, according to the character of the obstruction and may be accomplished suprapubically by cystostomy or trocar puncture by perineal urethrostomy in the male or by vaginal puncture in the female Suprapubic cystostomy is the method usually employed It is particularly useful in the preparation of patients for suprapubic prostatectomy when prolonged drainage must be instituted because of inoperable obstruction or bladder paralysis and following suprapubic prostatectomy or operations upon the bladder The bladder is usually drained by urethrostomy in cases of impermeable stricture of the urethra or when the urine must be diverted preliminary to plastic operations upon the urethra In the female surgical drainage of the bladder is rarely indicated Obstructive lesions of the bladder are infrequent and when the bladder must be put at rest drainage in most cases can be satisfactorily maintained by a urethral catheter The base of the bladder may be punctured

through the vagina and a catheter inserted when it is desirable to divert the urine from the urethra for a short period of time. This is particularly desirable when plastic operations are done upon the urethra. Vesicovaginal fistula does not result from this procedure if drainage is limited to two or three weeks If prolonged drainage is necessary suprapubic cystostomy should be done.

The pathological conditions of the bladder that usually require surgical treatment are diverticula, fistulas, tumors, congenital defects and injuries. The bladder is also frequently incised for the removal of stones, foreign bodies and obstruction at the vesical neck.

Previous to any operation upon the bladder it is desirable that a thorough cystoscopic study be made to determine accurately the character and location of the lesion. An x-ray examination including a cystogram is also a valuable diagnostic aid.

SUPRAPUBIC CYSTOTOMY AND CYSTOSTOMY

This operation of suprapubic cystotomy may be exceedingly simple when the bladder is distended or capable of being distended or it may be difficult if the bladder is thick and contracted Before the operation is begun a soft rubber catheter should be passed when possible and the bladder when infected thoroughly irrigated with an antiseptic solution. The catheter is fastened in place with adhesive for the purpose of distending the bladder at operation. The patient is placed upon a table in slight Trendelenburg position and the catheter is attached to a can containing a mild antiseptic solution. The can should not be placed more than two feet above the level of the patient's body and the solution should not be permitted to run into the bladder until the incision has been made through the abdominal wall. The distention of the bladder can then be controlled by sight and by palpation.

An incision is made in the abdominal wall, usually a longitudinal incision, and after separating the fibers of the recti and pyramidalis muscles, the transversalis fascia immediately beneath them is incised and the prevesical fat is exposed. The peritoneal fold in the upper portion of the wound is recognized and gently stripped upward with gauze. If it is opened it may be immediately sutured without danger. The fat is divided down to the anterior wall of the bladder and is then pushed to the side and downward into the space of Retzius. The vesical layer of the pelvic fascia adherent to the anterior wall of the bladder is divided transversely (Fig. 340) and the lower flap is dissected and sutured with two or three interrupted sutures of plain catgut to muscle at the lower angle of the wound, thereby securely closing off the space of Retzius (Fig. 341). It is well to place a small gauze pack at the upper angle of the wound in order to protect the peritoneal cavity from being accidentally opened while incising the bladder.

The bladder wall, having been recognized, may be fixed either by two Allis forceps or by two sutures of catgut inserted with a round curved needle. The fluid is then drawn off through the catheter in the urethra, and the bladder is incised between the two forceps or sutures. Fluid remaining in the bladder is

removed by an aspirator In this way the prevesical tissues are not flooded with the vesical contents and infection is less likely to occur Infection of the prevesical area is one of the greatest hazards of suprapubic cystotomy Prevention of contamination by infected urine and adequate postoperative drainage are essential features of the operation Where the bladder is distended from an impermeable obstruction the urine may be drawn off by thrusting a trocar and cannula through the bladder wall, which is incised after withdrawing the trocar and cannula It may occasionally be difficult to recognize the bladder wall if not distended, but when filled with fluid it is easily identified After the bladder has been opened, the incision is extended for better exposure or the stone is extracted or drainage instituted, according to the indications

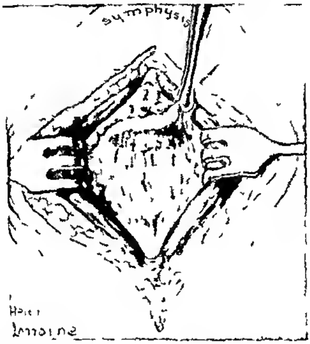

Fig 340—Suprapubic cystotomy The skin and fascia are incised and the recti muscles separated exposing the anterior wall of the bladder which has previously been distended with an antiseptic solution The thin fascia and fat are divided transversely and the lower flap is stripped downward

If the operation is done merely for drainage and exploration, a short vertical incision that will admit the finger is all that is necessary, but if a large tumor is to be removed, a more ample exposure is required Here the incision in the bladder wall should be transverse, keeping along its apex and as close to the peritoneal fold as seems safe If it goes down into the space of Retzius and near the urethral opening, it is difficult to suture and to heal If the incision in the bladder wall is short, a drainage tube is brought out at the upper portion of the incision and the lower margin of the wound is closed with catgut sutures These sutures in a short wound are interrupted, of chromic catgut, and take either none of the mucosa or as small an amount of it as possible In a larger bladder wound two layers of sutures should be used when closing the wound Bleeding in the bladder wound is controlled by whipping over the bleeding spot with small plain catgut in a round noncutting needle

through the vagina and a catheter inserted when it is desirable to divert the urine from the urethra for a short period of time. This is particularly desirable when plastic operations are done upon the urethra. Vesicovaginal fistula does not result from this procedure if drainage is limited to two or three weeks. If prolonged drainage is necessary suprapubic cystostomy should be done.

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the abdominal muscles and fascia. When they are tied the space between the bladder and the abdominal wall is obliterated. When the wound has been contaminated, a small rubber tissue drain is placed down to the space of Retzius and brought out near the lower angle of the wound. This drain should remain in place four or five days. In clean cases drainage is not necessary.

If a suprapubic cystotomy is done with the bladder collapsed, the abdominal incision is the same as when the bladder is distended, but the vesical wall is much more inaccessible. Having the patient in the Trendelenburg position is a great help. The incision is carried down to the pubic bone but the bone must not be exposed because of the danger of periostitis or osteitis pubis. The peritoneal fold lies just behind the pubis and exposure is aided by retracting the peritoneum upward with a piece of dry gauze as the prevesical tissues are divided transversely

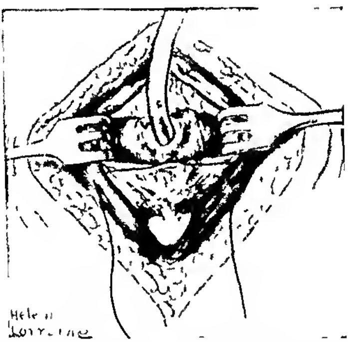

Fig. 34[illegible].—A stab wound has been made within the confines of the purse-string suture, a drainage tube inserted and the suture drawn taut and tied. The ends of the suture are threaded in needles and carried through the muscle and fascia of the abdominal wall. When tied they secure the bladder to the abdominal wall. If the bladder is to be explored or an operation performed within the bladder a transverse or vertical incision is made to open the viscus.

well behind the pubic arch. The anterior wall of the bladder is readily recognized by the coarse muscle bundles and the large, thin-walled veins over its surface. If the peritoneum is accidentally opened, advantage may be taken of the mishap to locate the dome of the bladder and the margin of the peritoneal reflection from within the peritoneum. No harm is done if the peritoneum is closed before the bladder is opened. When the bladder is located, Allis clamps are applied and the operation proceeds in the usual manner. Except in cases of trauma bladders that cannot be distended are usually severely infected and special care should be taken to prevent contamination of the prevesical area.

If the condition of the bladder has previously been determined by cystoscopy or cystogram, and the operation is done for drainage of the bladder, a purse-string suture of chromic catgut may be placed in the bladder wall (Fig. 341). After the bladder has been emptied with a catheter, a small incision is made within the confines of the purse-string suture, through which a drainage tube is inserted. The purse string is drawn taut, securely protecting the suprapubic wound from contamination (Fig. 342). The ends of the purse-string suture are left long and passed through the margins of the abdominal muscles and fascia, securing the bladder to the abdominal wall. This closes the space between the bladder and the abdominal wall and greatly facilitates the re-insertion of the suprapubic tube if it should be accidentally removed.

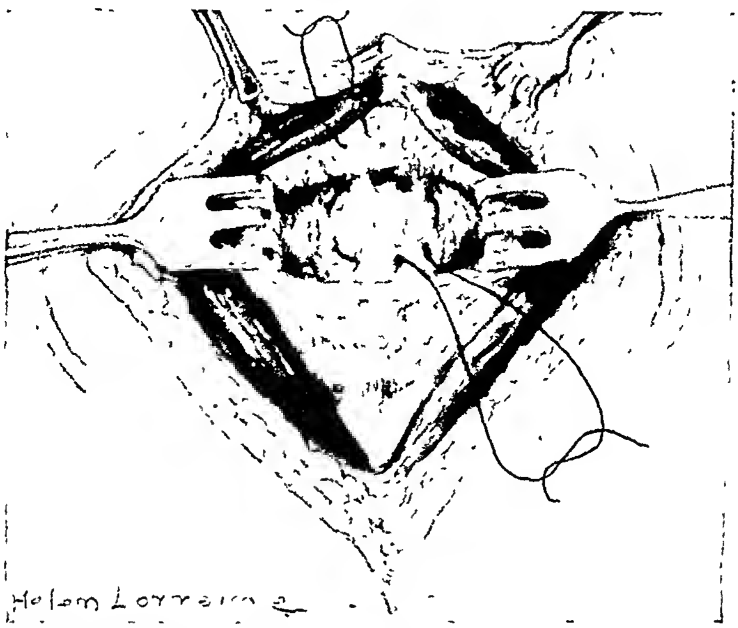

Fig 341 —The fascia and fat are sutured to the muscle in the lower angle of the wound, sealing off the space of Retzius, and a purse-string suture is taken in the anterior bladder wall

In some cases the bladder may be drained through the urethra and the suprapubic wound closed entirely. This method of treatment is quite satisfactory when bleeding within the bladder has been adequately controlled and when the bladder is free of infection. In some cases of tumor of the bladder, calculi, diverticula and hypertrophy of the prostate the period of convalescence may be thus decidedly shortened

A catheter, 18 or 20 French with two eyes, is so adjusted that about two inches protrude into the bladder. A larger catheter does not drain better and produces greater trauma to the urethra. A Foley catheter with 5 c.c. bag is good for this purpose. The bladder wound is then closed with two layers of 0 chromic catgut. The manner in which the sutures are placed is of little consequence if the margins of the wound are accurately approximated. The first layer of sutures should include the bladder muscle down to the mucosa. The first row of sutures is buried by the second At the upper angle of the bladder wound the ends of the second suture should be left long to be passed through

This method of drainage will not cause leakage around the catheter and the patient can be kept perfectly dry The catheter must not be removed, however, for at least two weeks unless as a preliminary step to an operation, because it takes about this much time for the granulations to produce firm tissue around its wall and so prevent infiltration of urine into the prevesical space If the catheter has become accidentally displaced in the first few days after such an operation and cannot be readily reintroduced, a suprapubic cystostomy should be done at once to protect the prevesical space from infiltration of urine

The danger of entering the peritoneum and piercing a loop of intestine should be borne in mind If proper care is taken this will rarely happen and the risk is more than balanced by the prevention of shock, the assurance of a dry wound, and the avoidance of infection, which may accompany suprapubic cystostomy and swing the pendulum against recovery in very debilitated and uremic patients, regardless of the seeming simplicity of suprapubic cystostomy Hospital records indicate a decided mortality rate from this procedure alone

Primary vesical calculi are frequently encountered in countries where the diet is constantly inadequate In this country they are found almost exclusively associated with inadequate drainage of the bladder Stones occasionally form around a foreign body or a ureteral calculus which has remained in the bladder Crenshaw reviewed 606 cases of vesical calculi of which 95 21 occurred in males and 4 79 per cent in females Seventy per cent of the patients were beyond fifty years of age The diseases most frequently associated with stones were hypertrophy of the prostate, stricture of the urethra, diverticula of the bladder and carcinoma of the bladder

Stones are usually removed by suprapubic cystostomy or litholapaxy Perineal lithotomy, one of the earliest urological operations, is now never used with the exception that small stones may be removed at the time of perineal prostatectomy

The choice of operation depends to some extent upon the experience of the surgeon With the exception of the larger medical centers or hospitals, vesical calculi are not encountered sufficiently often to permit familiarity with the use of the lithotrite, consequently the surgeon who must occasionally treat a patient with stone in the bladder will prefer cystotomy Litholapaxy is not indicated when the stone is extremely large or when there are numerous small stones It is also contraindicated in children or when there is a urethral stricture of small caliber, when the stone has formed around a foreign body, and when there is an associated pathological process that requires suprapubic cystotomy Litholapaxy is also inadvisable when the bladder is severely infected or extremely small or when the renal function is poor Prostatic hypertrophy is not necessarily a contraindication to litholapaxy If the prostate is of moderate size a transurethral resection can be done and the stone crushed and removed at the same time

In properly selected cases litholapaxy is the operation of choice The average period of hospitalization following litholapaxy is four or five days while suprapubic lithotomy requires a longer time There is less post-

With an *impermeable stricture* or a *prostatic obstruction* it is sometimes impossible to enter the bladder with an instrument through the urethra. These patients are often poor surgical risks and it is necessary to evacuate the urine by as simple a process as possible. Here a puncture with a trocar and cannula is usually safer than suprapubic cystostomy. A trocar and cannula is selected so that the trocar can be removed and a small soft rubber catheter threaded through the cannula into the bladder. The trocar and cannula should be of such a type that the urine can be drawn off through a lateral projection near the end of the cannula Before the operation the catheter is tested to see that it will go through the cannula easily. The skin of the abdomen is infiltrated with procaine solution, and an incision of half an inch is made just above the pubis and close to the pubic bone. The deeper tissues are infiltrated with procaine solution, and a proper trocar and cannula is grasped firmly, and thrust quickly into the bladder in a direction inward and upward. Of course this is never done except when the bladder is fully distended. If the trocar and cannula goes straight inward the prevesical space may be injured, the trocar will sometimes cut the bladder wall obliquely, and if there is a large prostate it may not enter the bladder at all. By directing the thrust upward as well as inward this accident to the prevesical space is avoided and there is no danger of injuring the peritoneum if the bladder is distended, provided the entrance point in the abdominal wall is just above the pubic bone.

If one is in doubt a small-caliber needle may be introduced and the bladder aspirated. The appearance of urine will indicate the proper location of the needle. The needle is withdrawn and the trocar and cannula immediately thrust through the same area in the same direction. When the instrument is felt to enter the bladder, the trocar is removed and a catheter which has been previously fitted to the cannula and in which an extra eye has been cut is inserted. A free flow of urine from the catheter indicates that it has entered the bladder. The catheter is shoved toward the bladder as the cannula is withdrawn over it If it is desired to empty the bladder gradually, a rubber tube is fitted over the lateral outlet of the cannula and clamped A catheter which fits the cannula snugly and has been closed at the distal end is promptly introduced when the trocar is withdrawn. The cannula is then withdrawn and the catheter is connected to a suitable decompression apparatus. If, during the first few hours of decompression, a small amount of urine escapes around the catheter no harm will be done.

The amount of catheter to be left in the bladder is determined by comparing it with another catheter of equal length There should be four inches of it below the level of the skin and if the patient is stout five inches would be better. It is wrapped around with adhesive at the skin level and fastened in position by a suture of silkworm-gut which goes through the skin and through the adhesive that is wrapped around the catheter but does not penetrate the wall of the catheter itself. The catheter should be new and should be tested before it is used. An old one will sometimes break and a portion of it may be left in the bladder.

This method of drainage will not cause leakage around the catheter and the patient can be kept perfectly dry The catheter must not be removed, however, for at least two weeks unless as a preliminary step to an operation, because it takes about this much time for the granulations to produce firm tissue around its wall and so prevent infiltration of urine into the prevesical space If the catheter has become accidentally displaced in the first few days after such an operation and cannot be readily reintroduced, a suprapubic cystostomy should be done at once to protect the prevesical space from infiltration of urine

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In properly selected cases litholapaxy is the operation of choice The average period of hospitalization following litholapaxy is four or five days while suprapubic lithotomy requires a longer time There is less post

operative discomfort following litholapaxy and a decidedly lower mortality. The higher mortality following suprapubic lithotomy is influenced to some extent by the fact that patients with complicating diseases are selected for this operation. The technique of suprapubic cystotomy has been described in this chapter. Associated pathology such as a diverticulum or hypertrophied prostate may be treated at the same time or at a second operation, depending upon the condition of the patient. If the bladder is infected or the renal function poor, the stone should be removed and the bladder drained until the patient has improved sufficiently to permit the associated pathological condition to be operated upon with reasonable safety.

VAGINAL CYSTOTOMY AND CYSTOSTOMY

When it is necessary to open the female bladder to remove stones or foreign bodies, vaginal cystotomy is the most satisfactory method. The wound heals readily and convalescence is shorter than when the operation is done suprapubically. The patient is placed in the lithotomy position with moderate Trendelenburg and prepared for a vaginal operation. A retractor is placed in the vagina posteriorly and the anterior vaginal wall is grasped in the midline and over the base of the bladder with two Allis clamps. An incision is made between the clamps through the vaginal wall. When the bladder is reached it is likewise grasped with Allis clamps and the incision is continued into the bladder. The bladder can then be explored with the finger and the stone or foreign body is grasped with forceps and removed.

The wound should be closed in two layers, the bladder with interrupted sutures of 0 chromic catgut accurately placed and avoiding the mucosa, and the vaginal incision is closed with interrupted sutures of No. 1 chromic catgut or kangaroo tendon. The bladder is drained for about ten days with a urethral catheter Healing is rapid and vesicovaginal fistulas do not occur when the incision is made through healthy tissue.

Vaginal cystostomy is occasionally indicated, especially when operations are done upon the female urethra A curved hemostat is passed through the urethra and the tip made to press against the base of the bladder just behind the trigone. An incision is made through the vaginal wall and bladder upon the point of the hemostat. A No 20 French catheter is grasped at the tip by the hemostat, pulled into the bladder about an inch and fixed to the vaginal wall by a heavy linen or silk suture. When drainage can be dispensed with, the catheter is removed and the bladder drained by an indwelling urethral catheter for a few days. In my experience the fistula has healed promptly.

PERIVESICAL DRAINAGE

Perivesical abscess may occur because of disease or injury of the bladder or posterior urethra or from a suppurative process in an adjacent organ. Ulceration and necrosis from tuberculosis or carcinoma of the bladder or extensive fulguration in the treatment of these conditions may permit extravasation of urine or extension of infection into the perivesical space. Abscess of the

perivesical area also occurs because of trauma of the posterior urethra or bladder, from either external violence or unskillful instrumentation. Perivesical suppuration has been frequently reported as a complication of transurethral resection of the prostate. The rupture of diverticula and extension from fulminating bladder infections are occasionally responsible. Abscesses in the perivesical area may also be caused by periostitis of adjacent pelvic bones, or suppurative processes of neighboring abdominal viscera.

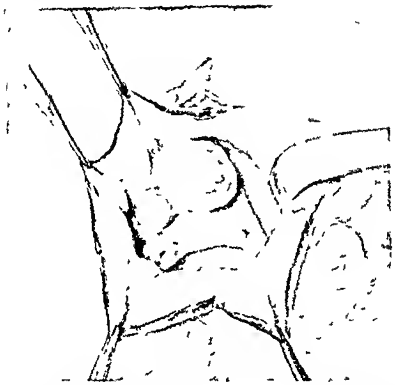

Fig. 343.—Retrovesical abscess probably caused by prostatic infection. The mass obstructed the bladder orifice and was believed to be a large ureterocele or cyst. Exposed suprapubically, it was incised and drained through a stab wound from the abscess cavity to the perineum.

Diagnosis.—The principal symptoms of perivesical suppuration are pain and tenderness in the suprapubic area, with the constitutional symptoms commonly associated with sepsis. Severe suprapubic pain and muscle spasm following injury of the pelvic area or instrumentation of the bladder or posterior urethra are suggestive of rupture of the bladder or posterior urethra with extravasation of urine, which when recognized and treated early does not necessarily cause suppuration in the perivesical area (Chapter XXXVI). Minor degrees of injury or necrosis of the bladder wall permit seepage of infected urine and the development of perivesical suppuration before the condition is recognized. Fever and prostration, varying with the extent of the suppuration, are often the first evidence of the disease. This is usually accompanied by pain and tenderness above the pubes or in the lower portion of the abdomen. There is frequently some spasm of the muscles of the lower abdomen and occasionally there is a tender mass which can be differentiated from a distended bladder by

catheterization. When the abscess is posterior to the bladder, the patient may complain of pain in the rectum or perineum and a tender mass can be felt above the prostate. Such an abscess is illustrated by Fig. 343. This patient presented symptoms of acute prostatitis, with fever, chills, and painful, difficult urination. On cystoscopic examination there was a mass elevating the base of the bladder. When the abscess develops rapidly there is gastrointestinal dysfunction, including distention, nausea, and vomiting; occasionally an adynamic ileus may develop.

A history of severe bladder disease or trauma is helpful in making a diagnosis. Retention of urine, with accompanying infection and prostatic abscess, can be ruled out by examination. Inflammatory disease of neighboring structures may give similar symptoms and must be differentiated by the history and examination.

Treatment.—Immediate and adequate drainage is essential. This is accomplished by suprapubic cystostomy and thorough drainage of the perivesical abscess cavity. When the abscess is very extensive, dependent drainage should be established through the perineum. This is particularly desirable in the management of retrovesical suppuration. In the case mentioned (Fig. 343) the bladder was opened suprapubically and the abscess evacuated through an incision in the base of the bladder. A drainage tube was placed in the abscess cavity through a stab wound in the perineum. A small catheter was placed in the abscess cavity and brought out by the side of the suprapubic bladder drainage tube. This permitted continuous irrigation of the abscess cavity. Recovery was rapid and complete. Continuous irrigation of the abscess cavity is very useful in removing necrotic material and preventing extension of the disease. The Carrel-Dakin method is very satisfactory. Some form of gentle, continuous suction is desirable when continuous irrigation is used. When the abscess is very extensive, a perineal urethrotomy for bladder drainage is preferable to opening the bladder suprapubically through an abscess cavity.

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CHAPTER XXVI

INJURIES OF THE BLADDER AND THEIR TREATMENT

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Severe injury of the bladder is a urological emergency The chance of recovery is dependent on prompt diagnosis and prompt surgical treatment

PENETRATING WOUNDS OF THE BLADDER

Penetrating wounds of the bladder are not uncommon in war from shell fragment gunshot or mine explosion, and are seen occasionally in civilian life as a result of accidents by impalement, such as falls on farm tools, stumps of saplings, or sharp boards In both civilian and military injuries, the penetrating agent gains entrance to the bladder through the buttocks, perineum, or lower abdomen, and therefore other organs as well as the bladder are frequently involved (Figs 344 and 345)

Robinson et al (1946) have submitted statistical data on casualties during the recent war In 100 cases of ruptured bladder they found that 50 per cent were of the extraperitoneal type, 30 per cent intraperitoneal, and 20 per cent of the combined extraperitoneal and intraperitoneal variety Seventy one per cent had associated injuries The most commonly affected organs were the small and large intestine (23 to 29 per cent), and pelvic bones (25 per cent)

Dodson (1944) has described a civilian case in which a young man fell backward on the sharp stump of a sapling which penetrated the buttocks and wall of the bladder We have seen another instance in which a child was impaled on a broken banister post, the large splinter perforating the rectum and bladder

Accidents in urological work include perforation of the bladder by the cutting loop of the resectoscope When this occurs, even though the patient is under spinal anesthesia acute abdominal pain is usually reported by the patient and should serve as adequate warning as to what has taken place Perforation of a contracted, diseased bladder by a cystoscope or sound has also occurred infrequently

In penetrating wounds of the buttocks perineum, rectum, or lower abdomen, bladder injury must always be considered Inability to void with a desire to do so, blood from the urethral meatus, or bloody urine from a passed catheter offer presumptive evidence of the injury

Because of the commonly associated abdominal injuries, laparotomy becomes the surgical approach, with palpation and repair of any rents in the posterior bladder wall after the repair of lacerations of the intestines Following abdominal surgery, which may include colostomy in the event of injury to the large intestine suprapubic cystostomy is mandatory Reliance on a urethral

catheter to drain the bladder is not good urological principle. In extraperitoneal rupture, drainage of perivesical tissues is always essential and for this we have always found cigarette drains placed through the suprapubic wound sufficient.

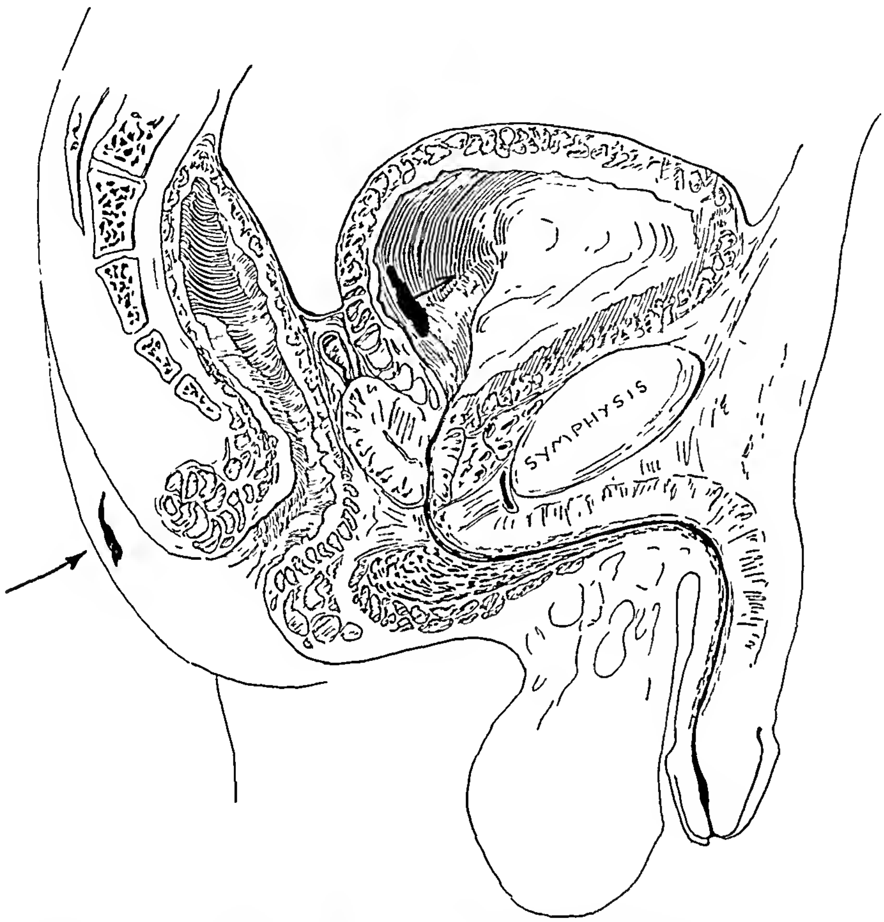

Fig 344 —Diagram of tract traversed by splinter found in patient's bladder following a fall backward on the stump of a sapling

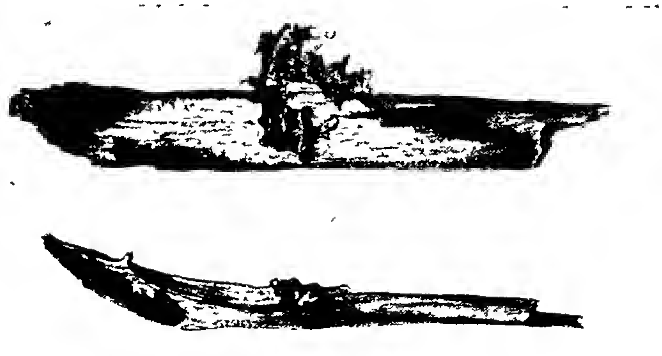

Fig 345 —Two views of oak splinter and leaf removed from patient's bladder twelve hours following accident (Reduced to 65 per cent of normal size)

Hard rubber tubes placed to the depths of the bony pelvis may facilitate irrigation of the dependent portions of the wound, but they may also erode large blood vessels and prove dangerous

Prompt and adequate drainage of the bladder suprapubically by means of a large Pezzer catheter or rubber tube is the important measure which the surgeon can contribute toward recovery. Robinson's data showing 80 per cent recovery confirm the value of this plan. Failure to close the rent in the bladder proved of secondary importance. At an appropriate time, depending on general condition and other injuries, if any, a urethral catheter should be passed to the bladder, the suprapubic tube removed, and the suprapubic wound allowed to heal. Rarely should this step be taken sooner than ten days after the initial surgery.

A survey of bladder injuries still in Army hospitals in the United States in October, 1945, by Prather and Robinson listed 141 patients. Because of serious injuries of other organs, 40 per cent were returned to this country for further treatment with the suprapubic wound still open. Surgical (secondary) closure was necessary in some. Bladder calculi proved to be a common complication, and all required treatment for urinary infection. After the suprapubic wound healed, bladder capacity proved normal in 88 per cent.

RUPTURE OF THE BLADDER

When the bladder is full, direct force applied to the hypogastrium may cause the bladder to rupture. The area of rupture is usually in the region of the fundus and posterior wall and leads into the peritoneal cavity—*intraperitoneal rupture*. This type of injury commonly follows falls or blows on the lower abdomen (Fig 346).

When the bladder is empty or nearly so, a twisting force applied to the bony pelvis, particularly the region of the pubic rami, may cause a tear in the bladder wall, usually on the anterior portion fairly close to the internal urethral orifice—*extraperitoneal rupture*. This type of injury is not uncommon in cases of fracture of the pelvis. Spicules of bone may also puncture the bladder (Fig 347).

A compilation of 1,798 cases of fracture of the bony pelvis by Prather and Kaiser (1950) disclosed that about 10 per cent had associated rupture of the bladder. Of those with bladder rupture, 82 per cent were extraperitoneal in type and 18 per cent were of the intraperitoneal type.

Even though the bladder may remain intact, hemorrhage around the bladder from blood vessels in the bony pelvis can produce a cystographic deformity known as a "tear drop" bladder. A combination of these forces is possible, of course, and may produce a combined lesion.

Symptoms and Signs.—The patient with a ruptured bladder usually complains of pain and soreness in the lower abdomen. He usually has a frequent desire to void, but can accomplish nothing or, at most, a small amount of bloody urine.

Shock may be present. Other injuries or a state of unconsciousness may mask the bladder injury. Generalized abdominal pain may point to injury of intraperitoneal viscus in patients with intraperitoneal rupture of the bladder. Severe pain from a fractured pelvis may mask the bladder injury temporarily.

Physical examination nearly always reveals tenderness and spasm of the lower abdomen. Swelling, edema, or evidence of beginning phlegmon above the pubis may be present. Dullness or flatness to percussion over the hypogastrium is common. Rectal examination may elicit tenderness or a

Fig 346—Diagrammatic sketch of intraperitoneal rupture of the bladder (From Prather Bladder Injuries Treatment, Past and Present, New York State J Med, Feb 1, 1953)

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diffuse mass. In cases of severe rupture of the deep urethra, the prostate and the bladder are torn loose, move upward, and a hematoma forms below them in the region where the prostate is normally situated.

Frequently the patient cannot void. Catheterization with a soft rubber catheter or, in expert hands, a Robinson catheter on a stylet is an important diagnostic step. To avoid repeating the catheterization for the x-rays, which will be necessary anyway, this step can be taken advantageously in an x-ray room under sterile precautions. During catheterization particular attention is given to the location of any obstruction in the region of the external sphincter or farther back at the bladder neck. Inability to catheterize the patient under these circumstances is presumptive evidence of ruptured urethra or bladder neck. Any unusual bleeding during careful instrumentation is also noted. The quantity and gross appearance of the urine is of interest, and grossly bloody urine, or at times what seems to be solely blood, is common.

Fig. 348.—Cystogram showing extravasation of opaque medium in case of extraperitoneal rupture of bladder and fractured bony pelvis. (From Prather: War Injuries of the Urinary Tract, *J. Urol.*, January, 1946.)

Diagnostic Aids.—If the catheter has been passed to the bladder, the insertion of a measured quantity of sterile water or saline and the amount of return through the catheter is a much quoted aid, but this procedure is likely to leave one in doubt.

Positive information can usually be obtained from a cystogram (Fig. 348) done preferably at the time of the original catheterization. For this we prefer sterile Skiodan 10 per cent, although 6 per cent sodium iodide will suffice. An injection of 60 to 120 c.c. should be adequate after a plain x-ray film of the bladder region has been taken. If extraperitoneal rupture of the bladder exists, diffusion of the injected opaque material into the perivesical tissue adjacent to the pubic rami should be evident. In cases with intraperitoneal

rupture, extravasation into the abdominal cavity should be evident if a modified Trendelenburg position is used for a moment before the film for the cystogram is taken (Fig. 349).

Gilbert and Dodson (1951) advise an additional x-ray film of the bladder after the cystographic medium has been evacuated from the bladder through the catheter This procedure should demonstrate a small area of extravasation that might have been masked by the cystogram.

Air cystogram followed by a film of the abdomen in semierect position may demonstrate air under the diaphragm if intraperitoneal rupture of the bladder has occurred (Fig. 350).

Shadows on the cystogram within the confines of the bladder may be caused by blood clots

Fig 349 —Retrograde cystogram showing intraperitoneal rupture of bladder (From Prather Bladder Injuries Treatment, Past and Present, New York State J Med, Feb 1, 1953)

When x-ray is not immediately available or a presumptive diagnosis must be made without cystogram, the following procedure sometimes proves helpful. After a catheter has been passed to the bladder and any contents evacuated, place a basin with water or saline between the patient's legs With a syringe (100 to 120 c.c capacity) inject air through the catheter, being sure to pinch off the catheter tightly when the injection is completed After disconnecting the syringe, place the distal end of the catheter under the surface of the fluid in the basin, unpinch the catheter and observe if there is an effective bubbling of air returning from the bladder region or whether little or none returns. If the bladder is intact there will be a significant return flow of

air The examination just described has at times proved more reliable as a diagnostic aid than a measured injection of fluid Neither is as informative as a cystogram

If the area of injury is not definite and if hematuria suggests rupture somewhere in the urinary tract, intravenous urography will help visualize both the renal and bladder areas, provided the patient is not in shock and therefore unable to secrete the opaque dye

Cystoscopy is not recommended as a routine procedure to demonstrate rupture of the bladder In some cases profuse bleeding obscures vision When rupture is present the use of large quantities of irrigating fluid or forced injection and suction by means of evacuators in an effort to obtain a clear visual field is contraindicated If the patient has a fractured pelvis it is unwise to chance further distortion of the bony fragments to obtain suitable body position for cystoscopy

Fig 350—X ray of the abdomen following air cystogram Anteroposterior projection with patient in lateral position right side up shows air in the peritoneal cavity Patient had an intraperitoneal rupture of the bladder

Occasionally, when there is minimal hematuria and no evidence of fractured pelvis, if other methods do not yield satisfactory information careful cystoscopy may be employed to advantage

Cipollo et al (1953) have described a fluorescein test for intraperitoneal rupture of the bladder They state that if 100 c c of 0 5 per cent solution of fluorescein is instilled into the bladder, it will not be absorbed into the blood stream unless the solution escapes into the peritoneal cavity Apparently a sufficient amount can be absorbed from the peritoneum in 5 minutes to give a positive test in the blood by means of a Wood's light

Treatment—Prompt surgery is essential The operation is often difficult because the bladder is collapsed and not always easy to identify quickly especially when obscured by perivesical accumulation of blood and urine Ade

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When clinical progress is satisfactory in patients who have had a urethral catheter in place from the time of initial operation, steps can be taken to permit the suprapubic wound to heal seven to twenty days after injury.

Patients in whom it has been impossible or impractical to have a urethral catheter inserted to the bladder at the time of operation will need drainage by urethral catheter during spontaneous closure of the suprapubic wound. When the urethral catheter cannot be inserted easily, surgical reconstruction of the deep urethra may be required (see section on rupture of the urethra).

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quate exposure is necessary. Local anesthesia is not desirable unless the patient's condition will not permit otherwise. A midline incision from the pubis toward the umbilicus is to be preferred. The primary aims of the operation are to provide drainage of the bladder by means of a large, suprapubic tube, and to ensure adequate perivesical drainage in those with extraperitoneal rupture. Secondary aims are closure of the rents in the bladder and aspiration of intraperitoneal urine if present

In cases of intraperitoneal rupture, the midline incision in the lower abdomen must be long enough to explore the peritoneal cavity. After incising the linea alba the full length of the wound, if there is no free fluid or blood in the prevesical space to indicate extraperitoneal rupture, the peritoneum is opened and urine suctioned from the peritoneal cavity. With the intestines pushed upward by means of pads and broad retractor, the posterior bladder wall is inspected, and the ruptured area located. With Allis forceps grasping the edges of torn area, the rent can be closed with a continuous chromic catgut suture. One layer will suffice unless the bladder wall appears extremely thin. The peritoneum can then be closed without drainage and the bladder opened caudal to the peritoneal reflection. The incision in the bladder should be sufficient to inspect it for further injury or other pathology. A No 34 F. Pezzer catheter or large, right-angle tube is then placed in the interior of the bladder and brought out at the upper end of the incision in the bladder wall. The bladder wall can be closed by a continuous chromic suture which acts both as a hemostatic and as an approximating suture A small Penrose drain is placed in the prevesical space underneath the fascia, and the fascia and skin are closed in separate layers

Supportive treatment in the nature of intravenous fluids, plasma, or blood may be needed before, during, or immediately after surgery.

For the first few days we prefer to have the major part of the fluid intake via parental channels and permit fluids by mouth only after the insult to the peritoneal contents has been overcome

Suprapubic drainage should be maintained for seven to ten days If at that time progress is satisfactory a urethral catheter can be inserted to the bladder for further constant drainage and the suprapubic wound permitted to heal after removal of the suprapubic tube.

In cases of extraperitoneal rupture, the midline suprapubic incision leads to an area of edema, serum and blood in the perivesical tissues The bladder may be empty and identified only by the muscular fibers and blood vessels on its anterior surface Suction in the depths of the wound facilitates proper exposure The aim of prompt surgery is to establish suprapubic drainage of the bladder, to drain the perivesical tissue with cigarette wicks up through the suprapubic wound, and to splint the deep urethra and bladder with a urethral catheter if this can be done without prolonging the operation beyond the tolerance of the patient

Supportive treatment and agents to combat deep pelvic infection, as well as bone infection in cases of fractured pubic rami, are important

rectum or vagina Sequestra from areas of osteomyelitis may penetrate the bladder, causing extravasation of purulent urine and eventually a vesicocutaneous fistula

Treatment—Much time will often be saved by a thorough examination of all patients with persistent suprapubic drainage The bladder should be examined for obstructive lesions or foreign bodies and the condition of the kidneys determined A severely infected kidney, especially if tuberculous, may require treatment or removal before satisfactory results can be obtained Operative treatment even for the relief of obstruction should be withheld until the bladder is as free as possible from infection Infection will frequently respond very rapidly to continuous irrigation, which may be carried out through a small catheter in the fistula with a catheter in the urethra for drainage If the urine is alkaline some mild acid solution should be used for irrigation, 0 5 of one per cent acetic or hydrochloric acid is quite satisfactory The infecting organism should be determined and appropriate internal medication administered In cases of proteus and staphylococcus infection it is very difficult to obtain an acid urine until the infection is under control Ulcers will heal more readily if lightly fulgurated This may be done through the cystoscope If there is no obstructive lesion or foreign body in the bladder, the fistula will often heal when the infection is cured

When these measures fail, the fistulous tract should be dissected out (Fig 351) and the bladder carefully sutured An incision is made, the center of which encircles the fistula The fistulous tract is dissected to the bladder and the scar tissue is carefully removed from the fascia and muscles of the abdominal wall The peritoneum is usually drawn down and is often adherent to the scar tissue It is therefore wise first to expose the bladder below and on the sides of the fistulous tract and to dissect very closely to the fistula above If the peritoneum is opened the margins of the peritoneal wound should be liberated from the adherent scar tissue and the peritoneum immediately closed with a continuous suture of plain catgut When the bladder is reached, the fistulous tract together with all scar tissue is excised The bladder is carefully examined, and if any obstruction has been overlooked, it is removed If there is no intravesical bleeding the bladder is closed in two layers of continuous sutures of chromic catgut A rubber drain is carried down to the bladder and brought out near the lower angle of the wound The abdominal wound is closed by interrupted sutures of nonabsorbable material Urethral drainage is provided by an indwelling catheter If because of enucleation of prostatic tissue or the excision of fibrous tissue at the bladder orifice in relieving obstruction intravesical hemorrhage should occur, the cavity should be packed with gauze and the bladder drained suprapubically

Fistulas accompanied by obstruction will usually heal after removal of the obstruction, which in most cases can be done by transurethral resection of the obstructing tissue or by dilatation of a stricture In some cases, especially those following prostatectomy, prompt healing follows the dilatation accomplished during a cystoscopic examination Following transurethral removal of tissue

CHAPTER XXVII

VESICAL FISTULAS

Fistulas of the bladder may communicate with the skin, the vagina, adjoining hollow viscera, or, rarely, with the peritoneal cavity. They may result from surgical procedures, traumas, or disease. The treatment varies with the location, the etiology and the environment of the fistula.

Vesicocutaneous Fistulas

Vesicocutaneous fistulas are usually situated in the suprapubic area and follow operations upon the bladder. They occasionally occur in the groin, the perineum or in the genital region as a result of injury or of osteomyelitis of the bones of the pelvis.

Delayed healing of a suprapubic bladder incision is one of the annoying complications of suprapubic cystostomy. The incision may fail to heal and there is continuous drainage, or the wound may close and open at varying intervals. Usually when the underlying cause is located and corrected, permanent closure will occur. The most frequent cause of persistent suprapubic fistula is obstruction. An overlooked prostatic mass, a stricture of the urethra, a foreign body, or fibrosis of the bladder orifice are the usual causes. Stones, diverticula or tumors are occasionally removed from the bladder and an obstructive lesion which is apparently insignificant is not corrected. A stricture of the urethra or stenosis of the meatus may have been overlooked if cystoscopic examination did not precede the operation. Constriction of the bladder orifice or dislocated portions of the prostatic capsule may cause persistent drainage after suprapubic fistula. The rapid formation of soft stones or foreign bodies such as portions of a tumor or small gauze sponges left in the bladder will result in delayed healing of the suprapubic wound. Healing is also retarded in contracted bladders and when the suprapubic wound becomes incrusted with alkaline deposits. A cystostomy in the presence of urinary tuberculosis is usually followed by a fistula which rarely heals until the principal tuberculous focus is removed. In a few cases persistent suprapubic drainage results from faulty surgical technique. The bladder may be sutured so that the mucous membrane is everted, or the bladder may herniate between the rectus muscles In other cases the incision may be carried too low, exposing the pubic bone, or the bone may be traumatized by too vigorous retraction, resulting in osteitis or osteomyelitis which in addition to its other disabling features contributes to delayed healing of the bladder.

Gunshot wounds or injuries of the pelvic bones may result in bladder fistulas, either as a result of direct injury or from abscesses which rupture into the bladder and are opened or rupture on the cutaneous surface or into the

rectum or vagina Sequestra from areas of osteomyelitis may penetrate the bladder, causing extravasation of purulent urine and eventually a vesicocutaneous fistula

Treatment—Much time will often be saved by a thorough examination of all patients with persistent suprapubic drainage The bladder should be examined for obstructive lesions or foreign bodies and the condition of the kidneys determined A severely infected kidney, especially if tuberculous, may require treatment or removal before satisfactory results can be obtained Operative treatment even for the relief of obstruction should be withheld until the bladder is as free as possible from infection Infection will frequently respond very rapidly to continuous irrigation, which may be carried out through a small catheter in the fistula with a catheter in the urethra for drainage If the urine is alkaline some mild acid solution should be used for irrigation, 0 5 of one per cent acetic or hydrochloric acid is quite satisfactory The infecting organism should be determined and appropriate internal medication administered In cases of proteus and staphylococcus infection it is very difficult to obtain an acid urine until the infection is under control Ulcers will heal more readily if lightly fulgurated This may be done through the cystoscope If there is no obstructive lesion or foreign body in the bladder, the fistula will often heal when the infection is cured

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or a dilatation of a stricture a catheter is tied in the urethra for drainage and the fistula is thoroughly curetted. The bladder should be kept clean by frequent irrigations under low pressure and the catheter should be changed twice a week. Healing is usually complete in from ten days to two weeks.

Recent fistulas resulting from injury frequently heal by suprapubic or catheter drainage if adequate drainage is provided for the involved perivesical tissues. When the fistulous tract has become well organized it is necessary to open the bladder and dissect out as much of the fistulous tract as possible and close the bladder defect in layers The remainder of the tract should be thoroughly curetted and perivesical drainage provided to the site of the former vesical end of the fistula The bladder should then be drained suprapubically If there is osteomyelitis of the pelvic bones any loose sequestra should be removed and the bone curetted, with provision for adequate drainage

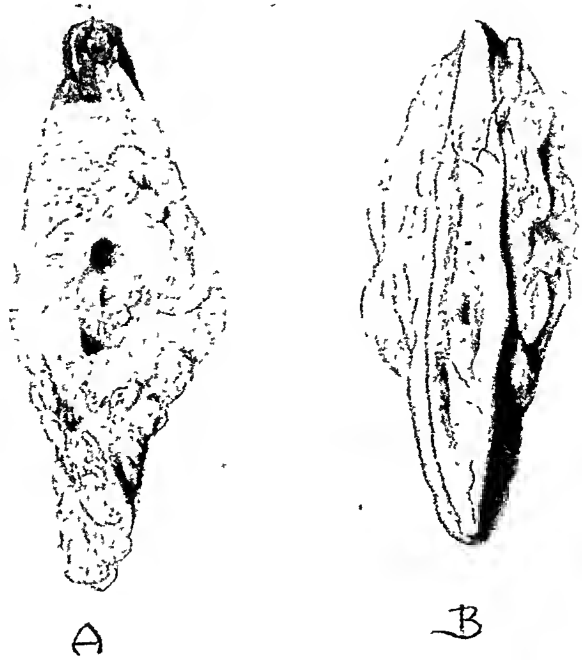

Fig 351 —Two views of specimens of suprapubic bladder fistula showing (A) mucosal and (B) cutaneous surfaces

Vesicointestinal Fistulas

Communication between the bladder and the intestinal tract occurs most frequently because of inflammation or carcinoma of the sigmoid and rectum. Diverticulitis of the sigmoid is probably the most common causative factor. Trauma, either operative or accidental, occasionally results in fistula between the intestine and bladder. Frequently such injuries involve the rectum The inflamed appendix occasionally becomes adherent to the bladder and eventually a communication occurs between the lumen of the appendix and the bladder. Pelvic abscesses sometime perforate into both the bladder and intestine, making a fistula between the two. Communication between the ileum and bladder usually results from tuberculosis of the ileum or from a foreign body such as a

nail or fish bone that sets up an inflammatory process in the ileum causing it to become adherent to the bladder, and finally perforates the wall of both structures and lodges in the bladder

Attention is usually called to a vesicointestinal fistula by the passage of gas or feces through the urethra If the bladder communicates with the rectum there may be watery stools, with very little urine passed through the urethra In some cases with a minute perforation a severe cystitis may be the only manifestation of the fistula The case history is often of value in determining not only the presence of a fistula but also its location Cancer of the rectum or bladder is usually known to exist before the appearance of a fistula from that cause In my own experience two cases of severe cystitis occurring several weeks following drainage of abdominal abscesses were found to be due to fistulas, one communicating with the appendix and the other with the sigmoid

The diagnosis is usually made by cystoscopic examination When the fistula is very small it may be hidden by the inflammatory reaction and edema, and may present the appearance of a bladder tumor A cystogram or a barium enema is often helpful in determining the presence and location of a fistula

Treatment—Vesicointestinal fistulas rarely heal spontaneously Those caused by external trauma, such as gunshot wounds or fractures, occasionally heal Inflammatory fistulas always require surgical treatment If the fistula connects the bladder with the colon or rectum, a preliminary colostomy should be done and the bowel below the colostomy kept clean by irrigations until the inflammation has entirely subsided, before an attempt is made to close the fistula The intestine requires the major surgical consideration and frequently a portion must be resected because of multiple diverticula, stricture, or a malignant growth When the bowel has been dissected from the bladder wall and properly disposed of, the fistulous tract through the bladder wall should be dissected out, removing all diseased tissue, and the wound carefully closed in layers with No 1 chromic catgut The bladder should be drained suprapubically until healing is complete Rectovesical fistulas involving the lower half of the rectum are more satisfactorily closed through the perineum with an exposure similar to that for operation upon the seminal vesicles A preliminary cystostomy should be done

A fistula involving the appendix readily heals after appendectomy and drainage of the bladder

Ileovesical fistulas usually require resection of a portion of the ileum

Fistulas resulting from carcinoma are rarely curable The disease has usually advanced beyond the possibility of radical excision A permanent colostomy will add to the patient's comfort and if the patient is not too debilitated x ray treatment may be helpful

Vesicovaginal Fistulas

Vesicovaginal fistulas result most frequently from a surgical injury or from pressure necrosis following prolonged difficult labor The bladder wall may be cut or torn during a difficult hysterectomy, either abdominal or vaginal With such an injury, leaking occurs rather promptly following the operation un

less the injury is recognized and the bladder repaired immediately. There may be delayed leaking when the bladder wall was included in a suture or was crushed by a hemostat. If the bladder becomes distended after immediate repair or if the sutures were not accurately placed, a fistula may result.

Fistulas following labor are usually larger than those resulting from surgical injury and in most cases result from necrosis. Occasionally the bladder is torn by forceps or by precipitate labor. In one case that came under my observation a laceration of the cervix included the bladder wall.

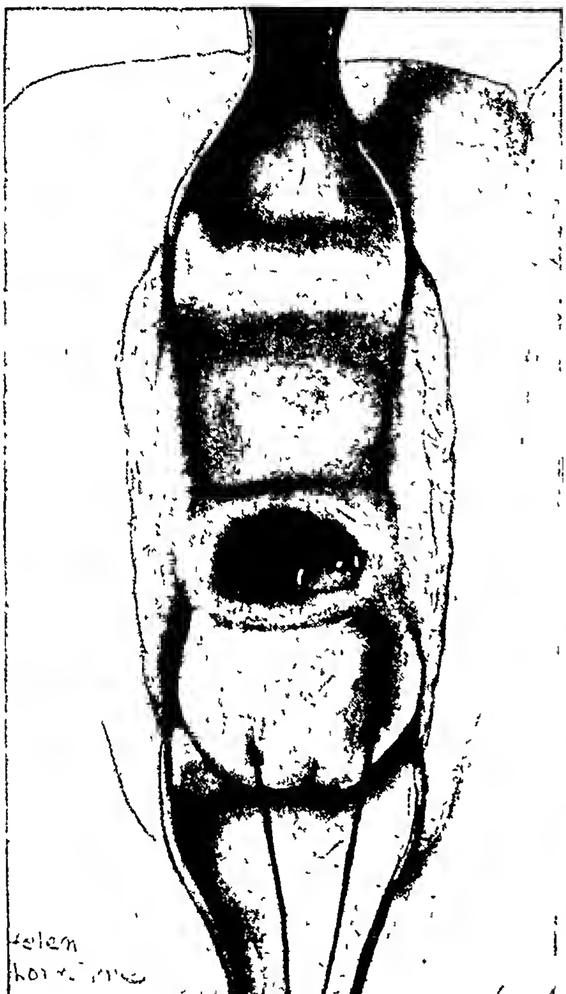

Fig. 352

Fig. 353

Fig. 352.—Large vesicovaginal fistula. The vagina is widely retracted and the cervix pulled down by a heavy traction suture which gives good exposure.

Fig. 353.—The vaginal wall has been separated from the bladder, sufficiently freed to permit easy approximation of the opening in the bladder. The first row of fine kangaroo tendon sutures has been taken, turning the margins of the bladder wound inward.

Fistulas occasionally result from carcinoma of the cervix or bladder. Such fistulas occur more frequently from the radium therapy in an effort to cure the cancer than from the growth of the tumor. Cases have been reported in which pessaries in the vagina have eroded into the bladder.

Diagnosis.—The diagnosis is rarely difficult. A fistula of the bladder is the usual cause of incontinence of urine following a pelvic operation, parturition, or the application of radium for cancer of the cervix. The possibility of a ureteral fistula must be remembered and excluded. Colored fluid such as a solution of methylene blue instilled into the bladder will promptly appear in the vagina when the two structures communicate. A cystoscopic examination is helpful in locating the fistula and in determining its relation to the trigone and ureteral orifices. If a defect cannot be seen in the bladder wall the ureter is the site of injury. This can be confirmed by giving indigo carmine intravenously and watching the ureteral orifices and the vagina. On the injured side the dye will appear in the vagina; furthermore, it is usually difficult or impossible to catheterize the injured ureter.

Treatment.—If an injury is recognized at the time of operation, the bladder should be immediately repaired and immobilized by a urethral catheter. If leaking occurs during convalescence a catheter should be inserted and the bladder kept clean and empty. Occasionally a small fistula will heal if the bladder is not permitted to become distended. Small fistulas (less than half a centimeter in diameter) surrounded by healthy tissue will frequently close following fulguration of the fistulous tract and catheter drainage. A light current should be used, just sufficient to destroy the epithelial lining of the tract. Vincent O'Conor, who has reported excellent results by this method, advises that the fistula be fulgurated from both ends and that the area be kept dry by drainage and posture. The method is of particular value in small fistulas opening high up in the vagina.

Vesicovaginal fistulas rarely heal without surgical treatment. The time of election for repairing the defect is six or eight weeks after the occurrence of the fistula. By this time all devitalized tissue has disappeared and the structures are not distorted by contracting scars.

Preoperative preparation is essential. If there is infection of the bladder or vagina, union of the tissues cannot be obtained. Frequently the urine is infected and the tissues of the vagina and vulva are eroded and encrusted. The urine should be made acid if necessary and the bladder and vagina frequently irrigated with warm boric acid solution. Crusts should be removed and 5 per cent silver nitrate solution applied to eroded or ulcerated areas three times a week until the tissues are in a healthy condition.

Vesicovaginal fistulas are usually approached through the vagina with the patient in the lithotomy position. Adequate exposure is important, and if the vaginal orifice is narrow, accessibility is secured by one or two posterolateral vaginal incisions. By placing a large retractor in the vagina posteriorly and pulling the cervix downward and backward by a tenaculum or by a heavy catgut suture passed through both lips of the cervix, the fistula can usually be brought well into view (Fig. 352). If the fistula is small and its margins are readily opposed without tension it may be closed with interrupted sutures of silver wire or silkworm gut. The mucous membrane is trimmed from the vaginal wall for a depth of about half a centimeter around the fistula

less the injury is recognized and the bladder repaired immediately. There may be delayed leaking when the bladder wall was included in a suture or was crushed by a hemostat. If the bladder becomes distended after immediate repair or if the sutures were not accurately placed, a fistula may result.

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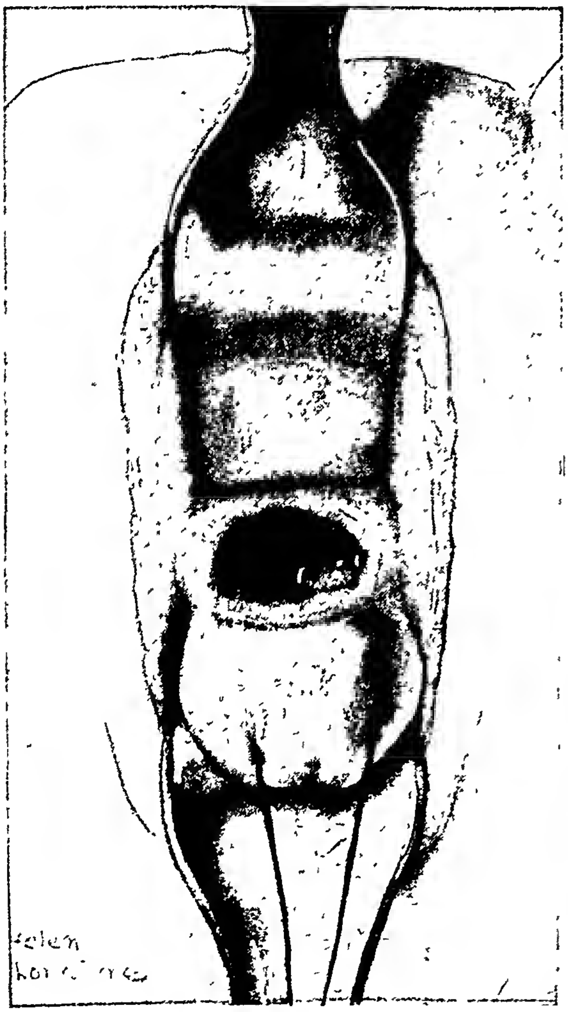

Fig 352

Fig 353

Fig 352—Large vesicovaginal fistula The vagina is widely retracted and the cervix pulled down by a heavy traction suture which gives good exposure

Fig 353—The vaginal wall has been separated from the bladder, sufficiently freed to permit easy approximation of the opening in the bladder The first row of fine kangaroo tendon sutures has been taken, turning the margins of the bladder wound inward

Fistulas occasionally result from carcinoma of the cervix or bladder. Such fistulas occur more frequently from the radium therapy in an effort to cure the cancer than from the growth of the tumor. Cases have been reported in which pessaries in the vagina have eroded into the bladder.

bladder (Fig 353) This is buried by a second row of continuous sutures (Fig 354) The wound in the vagina is closed in two layers, the first layer consists of interrupted mattress sutures of kangaroo tendon placed in an anteroposterior line about a centimeter apart and far enough from the margin of the wound to hold the vaginal wall up to the base of the bladder The excess tissue is then trimmed away, and the margins of the wound are approximated by a continuous suture of No 1 chromic catgut (Fig 355) If because of excessive scar tissue the vaginal flaps will not cover the entire bladder surface, the vagina should be lightly packed with vaseline gauze and the wound will heal by granulation

A catheter is placed in the urethra for drainage and immobilization of the bladder

Success in the repair of vesicovaginal fistulas depends to a great extent upon accurate and complete closure and placing the sutures in healthy tissue The proper preparation of the wound and the accurate placing of the sutures are often difficult by the vaginal route when the fistula is situated high up The approach is even more difficult if the cervix has been removed For these cases the suprapubic transvesical approach is more satisfactory

With the patient in moderate Trendelenburg position and under spinal or general anesthesia the bladder is exposed by suprapubic incision If the fistula is too large to permit the bladder to be distended with an antiseptic solution exposure will be facilitated by introducing through the urethra a curved sound, the tip of which is pressed upward against the anterior superior wall of the bladder After identifying the bladder and stripping the peritoneum upward sufficiently to permit ample exposure the anterior wall of the bladder is grasped by Allis forceps on each side of the midline and incised The incision is extended upward and downward until adequate working space within the bladder is obtained Bleeding from the bladder wound is controlled by sutures or ligatures Bleeding from the margins of the wound can be very annoying while attempting to work within the bladder cavity Retractors are then placed in the bladder and the fistulous opening is exposed (Fig 356) If the ureteral orifices are near the fistula they should be catheterized for protection

With a small sharp pointed knife an incision is made in the vesical mucosa surrounding the fistula and the mucous lining and scar tissue surrounding the fistula are excised The opening will then be considerably larger than the original but the margins will be soft and pliable The line of cleavage between the wall of the bladder and that of the vagina is identified and the bladder is separated from the vagina until the margins of the fistula can be approximated without tension

The vaginal and bladder walls are then sutured separately The vaginal wall is necessarily sutured first (Fig 356, A) The closure may be made by a purse string suture or by a continuous suture placed so that the margins of the vaginal wound will be turned into the vagina (Fig 357) If there is sufficient relaxation of the vaginal flaps two rows of sutures should be placed Chromic catgut or kangaroo tendon may be used in the vagina—I prefer kangaroo tendon Bleeding between the walls of the bladder and vagina should be carefully con

and scar tissue is removed until a healthy, bleeding surface remains. The margins of the mucous membrane of the bladder need not be disturbed. After determining the direction in which closure will produce the least tension interrupted sutures are placed. A tenaculum may be used to steady the margins of the wound. The sutures, of either silkworm-gut or silver wire, are placed about a quarter of an inch (0.6 cm.) apart, entering on one side near the freshened border in the vagina and emerging just beneath the mucosa of the bladder, then entering the other side just beneath the mucous membrane of the bladder and emerging on the vagina opposite the original point of entrance. The sutures are tied just tightly enough to approximate the tissues snugly without blanching Wound edges not approximated between the sutures are closed with superficial interrupted sutures of catgut.

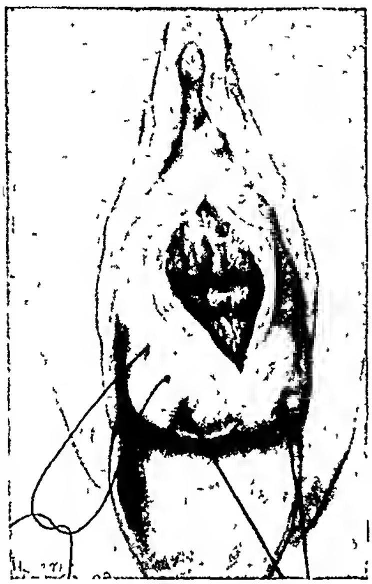

Fig 354

Fig 355

Fig 354 —A second row of fine kangaroo tendon sutures has been placed in the bladder wall covering the first layer In the lower angle of the vaginal wound the first of the interrupted sutures of kangaroo tendon has been placed

Fig 355 —The completed operation The vaginal wound has been closed with interrupted sutures of kangaroo tendon including all the layers and a continuous suture of No 1 chromic catgut, closing the margins of the wound

When scar tissue prevents approximation of the margins of the fistula without tension, when the opening is irregular in outline or larger than one centimeter in diameter, we prefer to dissect the bladder from the vaginal wall and close the wound in layers With a sharp-pointed knife and with scissors the scar tissue is trimmed from the margins of the fistula. The bladder is then dissected from the vaginal wall sufficiently to permit the margins of the fistula to be approximated without tension. Occasionally the posterior surface of the fistula must be dissected from the cervix. If the ureters open at the margins of the fistula, their orifices should be carefully turned into the bladder when the sutures are placed. Sometimes it is advisable to split a ureteral orifice back about half a centimeter. The bladder is closed in two layers. We prefer fine kangaroo tendon. The first sutures are interrupted and turn the vesical mucosa into the

trolled before the bladder wall is sutured The bladder wall is closed by interrupted sutures of No 1 chromic catgut accurately placed to include the entire thickness of the bladder wall except the mucosa and to invert the mucosa (Fig 358) The margins of the mucous membrane if not accurately approximated by these sutures may be united by a continuous suture of fine plain catgut

A suprapubic tube is placed in the bladder for drainage and brought out at the upper angle of the suprapubic bladder incision The bladder incision below the drainage tube is closed by two layers of No 1 chromic catgut The first layer includes the wall of the bladder down to the mucous membrane The second layer is taken through the superficial muscle fibers and reinforces the first A rubber tissue drain is placed to the space of Retzius and the abdominal wound is closed in layers No 1 plain catgut approximates the muscles, No 1 chromic catgut the aponeurosis, and fine chromic gut or silk unites the skin

Fig 357

Fig 358

Fig 357 —The defect in the bladder wall is closed with interrupted sutures of No 1 chromic catgut which avoid the mucosa

Fig 358 —The mucous membrane of the bladder is closed with interrupted sutures of fine plain catgut The bladder is drained suprapubically with a large tube which is removed and a catheter fastened in the urethra ten days following operation

The suprapubic tube is left in place about two weeks, when it is replaced by a urethral catheter until the suprapubic wound has healed By this time, 18 to 20 days after the operation, normal bladder function should be restored

The postoperative care of the patient is a very important part of the treatment Absolute and constant drainage is essential after any method of repair If the bladder is permitted to become distended even once during the first few days following operation complete failure may result Constant vigilance must be kept to see that the drainage tube is not occluded or kinked The importance of continuous drainage should be explained not only to the attendants but also to the patient so that the least evidence of bladder discomfort will be mentioned Until the urine is free of blood the catheter or drainage tube should

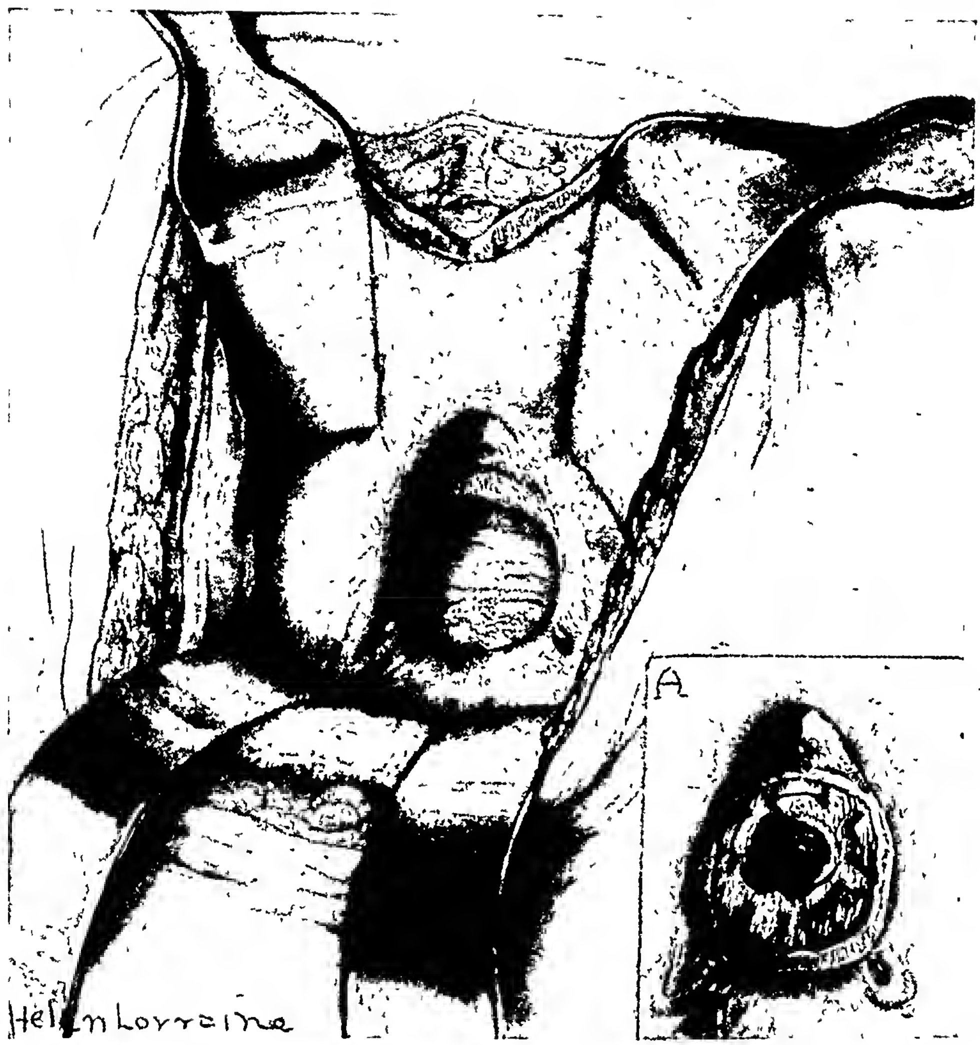

Fig 356—Suprapubic exposure for treatment of vesicovaginal fistula. Insert (*A*) shows the base of the bladder dissected from the vaginal wall and a purse-string suture taken to close the defect in the vagina The vaginal mucous membrane is sutured with the patient in lithotomy position after the operation on the bladder is completed

CHAPTER XXVIII

SURGICAL TREATMENT OF URINARY TRACT DYSFUNCTION DUE TO DISEASE OR INJURY OF THE NERVOUS SYSTEM

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Neurogenic bladder, cord bladder, and other terms have been used to describe the dysfunction that occurs following injury or lesions of the spinal cord or brain. These terms, while being descriptive, are not entirely correct, as they predicate a direct neurogenic involvement of the bladder, whereas the dysfunction results from an interruption of the nerve supply not only to the bladder but also to the sphincters and the abdominal and perineal muscles.

Although definite improvement has been made in the management of these cases, especially since the advent of the chemotherapeutic and antibiotic preparations, urinary tract complications are still the primary cause of death in the patient who survives the initial insult from disease or injury.

Etiology.—Any disease or injury that causes interruption of the ascending or descending nerve pathways in the brain or spinal cord may result in some type of bladder dysfunction, manifested by retention, overflow incontinence, and pseudo or true incontinence.

Diagnosis.—The type of bladder dysfunction may be predicted to some extent if the extent, site, duration, and nature of the lesion is known. In general it may be stated that an individual with a lesion or injury above the sacral reflex arc, which is located opposite the lower portion of the twelfth thoracic and first lumbar vertebrae, will eventually develop a reflex bladder, and the patient with a lesion below this level develops an autonomous bladder (Fig. 359).

Cystometry.—While not considered by all to be necessary in the management of bladder dysfunction, cystometry will enable one to determine many factors useful in treatment, such as the presence or absence of sensation, tonicity, and amplitude and number of abortive or emptying contractions.

A simple, combined cystometric and tidal irrigation outfit may be constructed inexpensively by materials available in any hospital (Fig. 360). Readings are obtained by placing the Y tube at bladder level and adjusting this tube with the manometer tube so that the zero mark is level with the symphysis pubis of the patient. After closing Clamp B, increments of 100 c.c. of fluid (sterile water or 1:40,000 Zephiran Chloride solution colored with methylene blue) are allowed to enter the bladder at a rate of 40 to 50 drops per minute. Clamp A is closed and after allowing time for the bladder to adjust to each increment of fluid a reading is made. This is the *passive* or

be flushed out with saline solution under low pressure every two or three hours After the urine is clear, irrigation is unimportant. If drainage is maintained through the urethra the catheter should be changed every four or five days because of the possibility of occlusion by deposits of mucous or inorganic material. The urine should be kept highly acid.

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involuntary pressure The patient is then asked to strain and the reading obtained is expressed as the voluntary or *active* pressure By plotting the difference between these two curves, the voiding potential is obtained and according to Mullenix, may be of benefit in predicting the prognosis

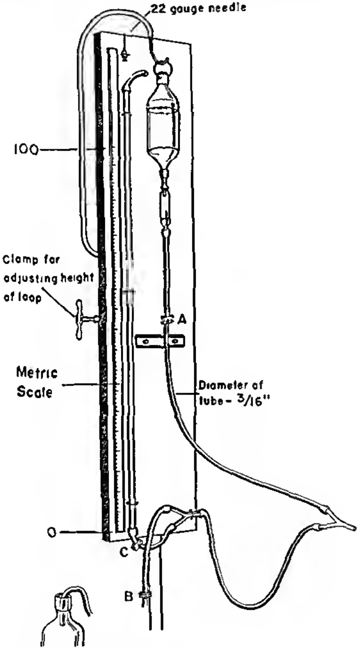

Fig 360 —A simple combined apparatus which may be used for cystometry tidal irrigation or intermittent irrigation

Sphinctometric readings may be obtained by connecting a catheter, which has been placed in the penile urethra distal to the external sphincter, to the water cystometry shown in Fig 360 and determining the amount of pressure necessary to overcome the sphincteric resistance

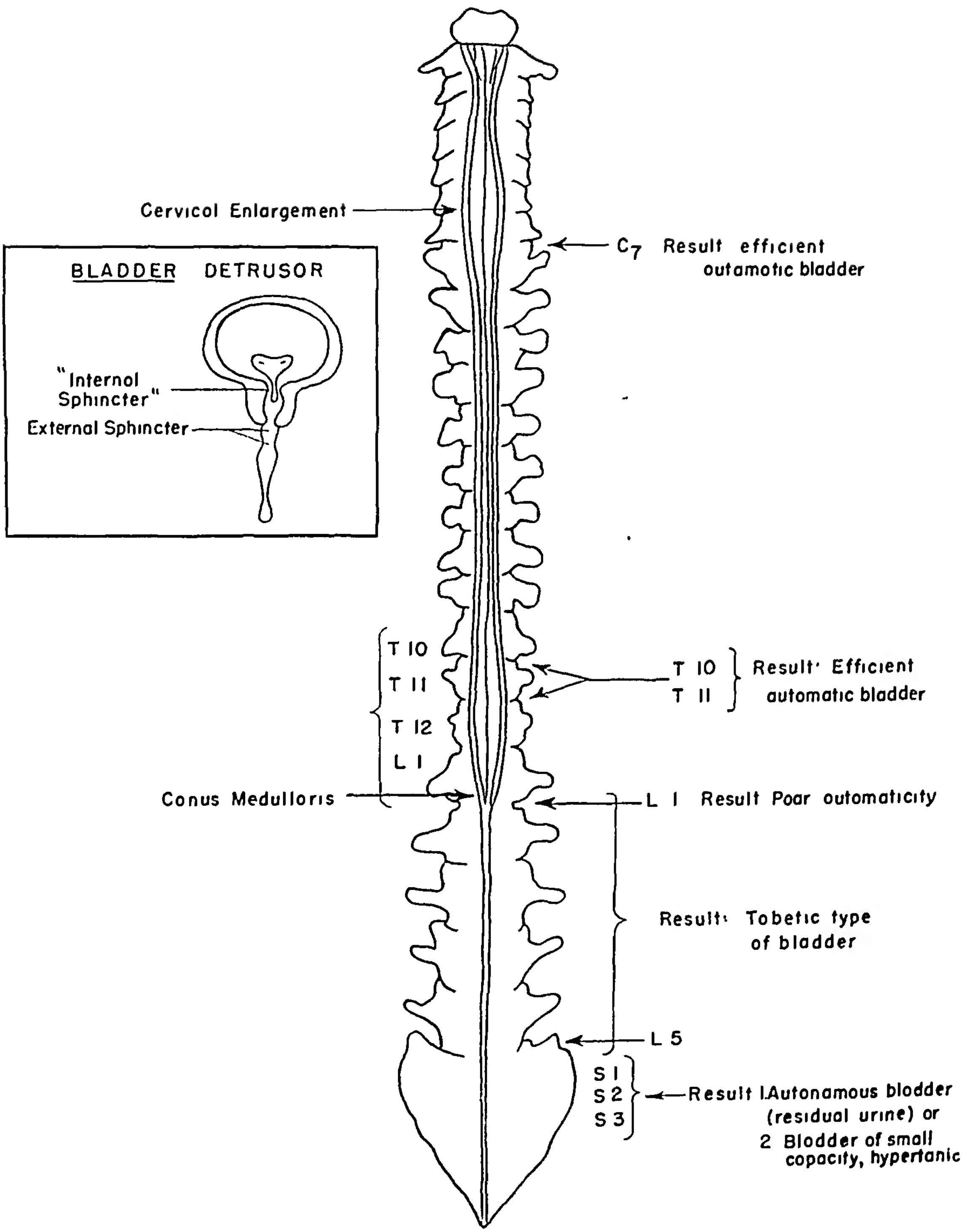

Fig 359 —Correlation of level of injury and abnormal types of micturition, if damage is complete at stated level

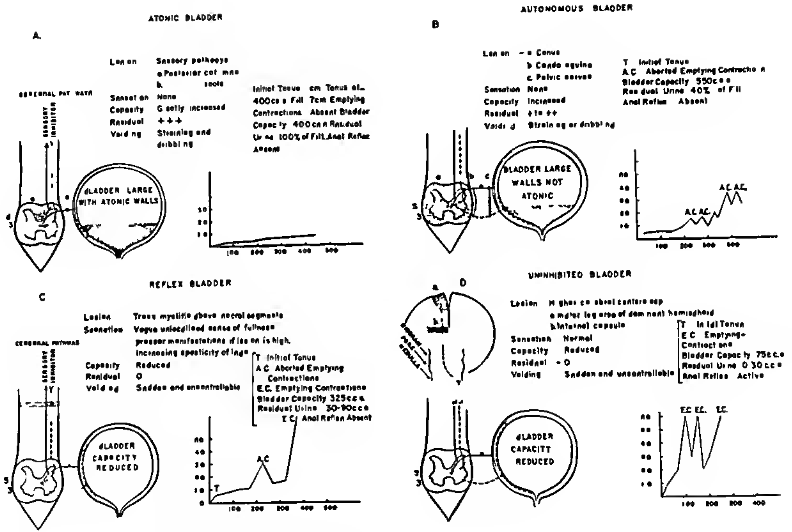

Fig 361 —Classification of principal forms of bladder paralysis (Redrawn and modified from White and Smithwick The Autonomic Nervous System ed 2 New York 1946 The Macmillan Co)

Classification.—There are four principal types of neurogenic bladder dysfunction, although many bizarre patterns of bladder activity which defy interpretation may be present. (Fig. 361.)

The Atonic Bladder.—There is probably never a complete loss of tone of the detrusor muscle if the bladder has not been allowed to remain overdistended for an extended period of time (Fig. 361*A*). Cystometric readings show sensation to be absent; abortive, contractions are absent, capacity is increased, and residual urine is large. Symptoms that may be present are hesitancy, dribbling, and loss of expulsive force

Examples: This type of bladder is present during the period of so-called "spinal shock" which always prevails for an indefinite period of time following injury to the spinal cord Conditions producing an atonic neurogenic bladder are syringomyelia, pernicious anemia, diabetes, arteriosclerosis, Pott's disease of the vertebra, spina bifida with meningocele or meningomyelocele, and tabes dorsalis.

The Autonomous Bladder.—This type of bladder (Fig. 361*B*) is the result of a lesion or injury which causes complete divorcement of the bladder from the central nervous system, and rarely occurs as a true type in injuries of the conus medullaris. The bladder contracts through its intrinsic nerve supply. Sensation is absent, abortive contractions are frequent but of a weak character, capacity is variable, residual is high. There is difficulty in voiding The bladder is distended

Examples: Lesion or trauma of the conus medullaris, cauda equina tumor, and nerve injury during abdominal-perineal bowel resection are questionable examples. Surgical interruption by sacral neurectomy, anterior-posterior rhizotomy, or subarachnoid alcohol injection—all are used in the treatment of the inhibited neurogenic bladder and result in the development of an autonomous bladder.

The Reflex Neurogenic Bladder.—This type of bladder dysfunction (Fig. 361*C*), commonly spoken of as an "automatic bladder," is the result of trauma or disease causing a complete transverse transection of the cord above the sacral reflex arc Sensation is absent. Abortive contractions are weak and frequent during the period of recovery from spinal shock but become infrequent when recovery is complete Residual urine varies, depending on the general condition of the patient, but is usually small in quantity. The well-balanced reflex bladder with involuntary voidings at 1 to 3-hour intervals is to be hoped for, but a large percentage of these patients because of complicating factors void at irregular intervals, with involuntary spurts of urine.

Examples: trauma, neoplasms, postoperative conditions, viz., herniated nucleous pulposis, cordotomy, following spinal anesthesia, Parkinson's disease, infectious transverse myelitis, multiple sclerosis, amytrophic lateral sclerosis, and transverse myelitis resulting from rabies vaccination and tetanus antitoxin injection.

The uninhibited bladder is a bladder (Fig. 361*D*) in which suprasegmental control either has failed to develop or has been interrupted. This results in the bladder's being controlled through the sacral reflex arc. It will be

cent procaine are made in the skin along the lateral border of each rectus muscle from the level of the umbilicus to the symphysis to block the operative field. Other injections are made along the proposed line of incision and directly over the symphysis. The incision should be 7 to 9 centimeters in length to ensure adequate exposure. It should extend from the symphysis to the umbilicus in the midline. The bladder is distended with fluid through a urethral catheter until it is palpable in the operative field. It is identified through the transparent tissue superficial to it by its oblique muscular fibers and prominent blood vessels. It is exposed first in the midline about one inch above the symphysis. The transverse reflection of the peritoneum can be felt between the upper and middle thirds of the vesical bulge. Novocain in 0.5 per cent solution is injected into the bladder wall before freeing the fascia and peritoneum from it.

The bladder is exposed laterally to accommodate a second row of sutures in its wall at the time of closure. It is then grasped above with tenacula and emptied through the urethral catheter. The vesical incision is made high and is from 4 to 6 centimeters in length.

The lumen of the bladder is next examined for stones. A No. 24 F. Pezzer catheter is inserted. The bladder wall is closed with a double layer of plain catgut sutures which pass through the mucosa but do not close the wound tightly around the catheter. This allows a space for urinary drainage, in case the tube becomes occluded. A suture of chromic catgut placed through the greater thickness of the bladder wall, abdominal muscles and fascia apposes these structures and separates the peritoneum from the Pezzer catheter. The fasciae of the abdominal muscles are approximated with interrupted stitches of chromic catgut. A centimeter of open space is left above and below the site of the catheter. The skin is closed with interrupted sutures of silkworm gut. The wound is drained near the site of the tube and also midway between the tube and the lower end of the wound.

A loop in the drainage tubing, which has been filled with fluid, prevents leakage of air into the bladder and provides enough suction to keep the area around the tube dry.

Prather urges that the cystostomy tube be left in the bladder at a level which prevents its impingement on the urinary trigone. He also recommends that the tube be brought through the upper end of the bladder in an oblique course to the skin. Healing is then more rapid once the tube is removed. This high location of the tube enables the operator to reopen the bladder safely if it becomes necessary. The sinus tract lies between the old incision and the peritoneum and protects the latter from surgical injury.

A Penrose drain can be passed alongside the suprapubic catheter into the space of Retzius. If the patient is to be ambulatory immediately after surgery or if spastic seizures are present, two stay sutures of silver wire, which include muscle, fascia and skin, should be left in place for two weeks. These prevent hernia and dehiscence of the wound.

noted that the bladder responds to a minimal amount of fill, sensation is present, capacity is reduced, abortive contractions are strong and frequent Symptoms produced are urgency and a precipitous type of urination, producing a pseudo type of incontinence; difficulty in urination and retention are less common symptoms.

Examples. The completely uninhibited bladder is the bladder of infancy. The incompletely inhibited bladder is seen in some patients suffering from enuresis and is probably the result of failure of the development of the inhibitory centers. Acquired causes are cerebral vascular accidents, trauma, tumor, meningo-vascular syphilis, multiple sclerosis and following prefrontal lobectomy.

Care of the Early Neurogenic Bladder.—In the early treatment of the neurogenic bladder our main concern is the relief of urinary retention by drainage and the prevention or holding to a minimum bladder and other urinary tract infections, by irrigations and other therapy.

Methods of Drainage.—*Constant indwelling catheter* drainage is the method of choice when possible. A No. 14 or No 16 F Foley catheter is inserted, preferably before myogenic damage occurs One advantage of urethral drainage is that the bladder is allowed to act as a single, physiologically functioning unit, as there is no break in the continuity of the bladder musculature. Also, rehabilitation is shortened, as extra time is not needed for healing of the suprapubic fistula. In most patients who have had prolonged cystostomy drainage, it is necessary to increase the capacity of the bladder following discontinuance of drainage. In a survey made by us, in which we compared the end results of bladder function following urethral or cystostomy drainage, we noted that poorly functioning bladders were found more often and vesicoureteral reflux was present in almost twice as many of the patients who had drainage by cystostomy tube.

Among the disadvantages of continuous urethral catheter drainage is the high incidence of periurethral infection, with abscess and diverticula formation. These can be held to a minimum if gentleness and aseptic techniques are rigidly observed when introducing a catheter of small caliber (No. 16 F.). Reduction of the angulation of the urethra in the region of the penoscrotal junction by taping the penis back on the abdomen has been found to be helpful in the prevention of these complications.

Suprapubic Cystostomy.—This procedure is indicated whenever drainage of the bladder by urethral catheter is impractical. Lack of facilities for close observation and nursing care is the commonest reason for its use Other indications are incontinence in the female, periurethritis, periurethral abscess, and epididymitis unaffected by chemotherapy or antibiotics. However, by using a small (No. 18 F.) urethral catheter, which can be kept draining constantly, cystostomy can often be avoided.

The technique has been discussed by Boyd. In lesions of the thoracic cord, no anesthetic agent may be necessary. If suprapubic sensation exists, the procedure can be done under local anesthesia. Two injections of 2 per

rhythm, with the occurrence of emptying contractions with the same amount of fill. The catheter is then clamped off from 1 to 3 hours for several days, after which time it is removed. Fortunately, most paraplegics have some warning of an impending emptying contraction. In the patient with a low lesion (below 7T 8T) there is a vague sensation in the lower abdomen when the bladder capacity is reached. The patient with a high lesion (C4 to T7 T8) will not have the sense of fullness in the suprapubic area, but autonomic nervous system manifestations (pressor effects), such as sweating, chillblains, hot or chilly sensations, or headache, will be present when bladder capacity is reached.

The patient who knows his bladder capacity and will regulate his fluid intake may by interpreting the micturitional reflex initiate a reflex emptying contraction by pressure over the lower abdomen and thus avoid incontinence. A considerable number of patients will continue to have stress incontinence or incontinence while asleep. The former may be controlled by a light weight urinal, and the latter by taping a condom to the penis with the closed end punctured and taped to a drainage tube.

The majority of patients handled in the manner described will develop a balanced bladder if a true prostatism is not present. On occasion a well functioning bladder may revert back to imbalance because of complicating factors such as bladder calculi, infection, decubiti and poor nutrition. Retraining will then be necessary. A smaller number may not obtain a well balanced bladder and other methods must be used.

Drugs.—Parasympathomimetic drugs such as urocholine, Mecholyl, Doryl and Furmethide may produce temporary response in the patient with weak detrusor muscle contractions and have their greatest use in conditions of a temporary nature such as stimulation of the detrusor following pelvic or rectal surgery.

The parasympatholytic or anticholinergic preparations such as atropine and Banthine or pro-Banthine have been found by Lapides and Dodson, Jr., to have a beneficial effect by blocking the parasympathetic ganglion in the patient with an uninhibited bladder such as seen in multiple sclerosis, postcerebral vascular accidents and postcerebral leukotomy.

Presacral Neurectomy.—Interruption of the sympathetic fibers in man results in very little alteration of the bladder physiology. No change has been noted in bladder function following removal of the hypogastric plexus and nerves for the relief of pelvic pain in the female patient.

Pudendal Block or Neurectomy.—Imbalance of the bladder may be found to be due to the presence of a spastic external sphincter and pelvic musculature combined with weak detrusor contractions. The bladder may be brought into balance by *pudendal block*, which is carried out by placing the patient face down with the table slightly broken and tilted forward. A regulation size spinal needle is introduced at the mesial border of the ischium for two to four centimeters and then tilted toward Alcock's canal and pushed slightly forward, and 25 to 30 c.c. of Novocain, one per cent, is injected into and around the nerve

Two weeks following cystostomy the catheter is changed weekly. Later the bladder capacity is maintained at 300 or 400 c.c. by daily stretching. Irrigations should be performed at least twice daily in the prone position to wash exudate from the base of the bladder.

Perineal urethrostomy performed as described in Chapter XXXIII is very useful in the diversion of the urinary stream for treatment of urethral complications, this being especially true if the patient has formerly undergone cystostomy drainage. It does not prevent the development of genital sepsis

Drainage by *intermittent catheterization* is only mentioned to be condemned. This procedure was used in World War I with disastrous results due to uncontrollable urosepsis.

Manual evacuation by the Credé pressure still has a few advocates who use this method in the acute phase of neurogenic bladder dysfunction. This method requires the presence of trained personnel at all times and may prove to be dangerous in the presence of bladder infection or obstruction. It has been found to be very beneficial in the handling of the sensory paralytic bladder of tabes, and the hypotonic autonomous bladder with weak expulsive force and a high residual urine.

Methods of Irrigation.—The *manually controlled* type of intermittent irrigation may be carried out by an attendant, relative, nurse, or by the patient if he has the use of his hands The apparatus illustrated in Fig. 360 may be used by closing Clamp C and first opening Clamp A with Clamp B closed and letting the desired volume of fluid (200 c c to 250 c.c) enter the bladder. Clamp A is then closed and B opened to evacuate the contents of the bladder.

Tidal irrigation or drainage, if properly controlled by competent personnel, is said to result in the earlier development of a reflex type of bladder. The principal objections to this type of drainage are that it confines the patient to bed for longer periods of time, air-trapping within the tubes takes place quite often, and the bladder fails to empty completely.

Referring again to Fig. 360, it is only necessary to place a No. 22 gauge needle in the small piece of rubber tubing at the top of the tube used for cystometric readings; the tube loop is then adjusted to such height as previously determined by cystometric studies and Clamp A is opened to allow 30 to 40 drops per minute of fluid to enter the bladder. Solutions that may be used are sterile water, Zephiran Chloride solution 1 40,000, boric acid, acetic acid, or weak buffered organic acid solution, viz , Suby's or Albright's

Care of the Chronic Neurogenic Bladder.—After the period of spinal shock has passed, during which time the bladder has been constantly drained, there are four objectives that should be met if we are to obtain the ideal neurogenic bladder first, the establishment of urethral voiding; second, a bladder with sufficient capacity to act as a reservoir, and this with consistency; third, a bladder that will completely empty itself with little or no residual, and fourth, a sufficient degree of control to avoid incontinence. These objectives may be facilitated by using one or more of the following procedures.

Bladder training as advocated by Munro consists of the routine use of tidal irrigation, which in many instances results in the bladder's developing a regular

main intact, as they are necessary to initiate an emptying contraction, this being especially true in the patient who has an autonomous bladder following sacral reflex arc interruption. Under no circumstance should the sacral reflex arc be eliminated in the patient who has a functioning reflex bladder. The subject should always be forewarned of the possibility of the loss of penile erections. Although Bors reports 18 of 24 patients developed voluntary micturition with little or no residual in patients who had complete cervical or thoracic lesions, it is rather difficult to understand how a patient with the loss of abdominal muscle contractions and the possible loss of the use of the upper extremities, with an autonomous bladder produced by alcohol injection can develop a "voluntary micturition" and "void every two hours by the clock, with little or no residual urine." Our permanent results in 19 patients have not been so favorable and only 3 can be said to have had a good result. These 3 patients had lesions of the lower thoracic cord and transurethral resection of the bladder neck. Brendler et al. report the disappearance of vesicoureteral reflux in 5 of 12 patients in whom they performed anterior posterior rhizotomy. Hutch states that there is a lessening of the degree of hydroureter and hydronephrosis and decrease in the caliber of bladder trabeculations in those patients who have had the sacral reflex arc interrupted.

Sacral Block and Neurectomy.—It has been noted that in certain patients who do not have bladder neck obstruction, residual urine persists in the presence of a hypertonic type of bladder. This has been attributed to inhibitory impulses being present in the sacral reflex arc. By elimination of the sacral reflex arc a true autonomous bladder is produced and if the abdominal muscle nerve supply is intact, residual urine may be eliminated.

Sacral nerve block is accomplished by the injection of Novocain, bilaterally, into either one or a combination of the sacral roots. Data are obtained by cystometry and sphinctometry before and subsequent to the block.

Sacral Neurectomy.—Meirowsky et al. describe sacral neurectomy as follows: "Prior to the operation needles are placed in the foramen, skin markings are applied with the needles in place and checked by x-ray to confirm the position of the individual foramina. A longitudinal skin incision is centered over the middle sacral crest. Superiorly it extends to the level of the posterior superior iliac spine. The inferior boundary corresponds to a point one centimeter below the sacral cornua. The incision is then carried through the posterior layers of the lumbodorsal fascia to the middle sacral crest which is formed by the sacral spinal processes. The tendinous origin of the sacrospinalis muscle is sharply severed from the sacral spinous processes. By the use of a chisel or a sharp periosteal elevator the sacrospinalis and the multifidus are dissected subperiosteally so as to expose the dorsal surface of the sacrum. In doing so, the articular crest is encountered bilaterally. Between the latter and the lateral sacral crest the four sacral foramina are found. It is, therefore, necessary to retract the paraspinal muscles to the lateral sacral crest.

"The dorsal surface of the posterior sacral foramina is covered by a thin, ligamentous tissue. On the fatty tissue beneath this ligament numerous

Pudendal neurectomy as described by Huggins and others is performed as follows· Under local or sacral block anesthesia an oblique incision is made from the lower part of the sacrum to the tuberosity of the ischism. The gluteus maximus is split and retracted The underlying sacrotuberus ligament is identified and sectioned. The fat of the ischiorectal fossa is exposed by opening the next layer, the obturator fascia. The internal pudendal artery lying next to the nerve can usually be palpated along the medial surface of the tuberosity of the ischium. The nerve is picked up and sectioned after stimulation.

Although there has been improvement reported from simple block and pudendal neurectomy by Bors, Huggins and others, it is our opinion that until further series of cases are reported with *permanent* favorable results, neurectomy will be found to be rarely indicated In a study of 17 patients in which we thought the procedure might be indicated, improvement was noted in two patients with incomplete lesions who were ambulatory, without the use of artificial aid, following Novocain block alone. Neurectomy was carried out on one patient with a favorable result.

Spinal Anesthesia, Subarachnoid Alcohol Injection, Anterior-Posterior Rhizotomy.—By these listed procedures an upper motor neuron lesion is converted into a lower motor neuron lesion

In analyzing the underlying reasons for the failure to develop a better bladder in 69 of 170 patients, we found that spasm was the probable cause in 31. In all of these patients, the lesion was located in the cervical or thoracic cord. Transection of the cord below this level rarely results in spasms. It is believed that the bladder imbalance that results is due to extraneous impulses entering the sacral reflex arc and causing emptying of the bladder, not dependent upon the amount of fill

Spinal Anesthesia—Before a permanent procedure is to be carried out, spinal anesthesia with Novocain injected into the second lumbar interspace will establish evidence of the effects to be expected.

Rhizotomy is used primarily for the control of skeletal spasticity, especially in those in which rehabilitation is being delayed because of flexion deformities (and disorders developing secondary to such deformities). In the patient who has an unbalanced bladder the sacral roots, both anterior and posterior, must be sectioned, as it has been found that control of the skeletal muscular spasm of the extremities has no effect on bladder contractions

Subarachnoid alcohol injection may be substituted for anterior-posterior rhizotomy, as it accomplishes the same result, and it may be especially useful in the patient who has decubiti located near the operative field or who has such extreme flexion deformity that positioning for operation is impossible

Procedure: After it has been determined that the bladder may be brought into balance, by testing with spinal anesthesia, 10 to 15 c.c. of absolute alcohol is injected into the second or third interspace. The patient is maintained in Trendelenburg position for 24 hours. In performing subarachnoid alcohol block, it must be kept in mind that the nerve supply to the abdominal muscles must re-

reported a series of patients subjected to resection of the bladder neck. We have carried out transurethral resection 210 times in 167 patients among 860 paraplegics (19.4 per cent) without mortality. Results have been favorable in 83 per cent of our patients. It is probably the best single means of converting an unbalanced to a balanced neurogenic bladder.

Surgery of Complications.—*Renal and Ureteral Calculi.* The paraplegic patient tolerates surgery of the urinary tract unusually well. This is probably due to the development of an effective resistance to the common infecting organisms present in the urinary tract of all paralyzed patients. There is very little difference in surgery for upper urinary tract calculi in the paraplegic and in the normal individual, and if surgery becomes necessary it is carried out as described in Chapter XI (Renal Calculi and Their Treatment), Chapter XVIII (Surgical Approach to the Ureters), and Chapter XXI (Ureteral Calculi and Their Treatment).

Although the surgical principles for the management of upper urinary tract calculi are the same for the paraplegic as for the normal individual, there are several points that should be emphasized in applying these principles in the paralyzed patient. As symptoms are rarely present in the paralyzed patient one must depend upon the routine use of x-rays with the immediate employment of excretory urography in the patient who develops a fever of undetermined origin. Conservation of renal tissue is of paramount importance in the paraplegic because of the higher incidence of recurrence of calculi. Surgery for removal of renal calculi not causing obstruction should be postponed where possible until the patient is no longer confined to his bed, as this is one of the main factors in the formation of renal calculi. Hypercalcemosis present to some degree in all paraplegics, is another of the factors in the production of calculi but is probably only incidental, and without the presence of stasis and infection would not be of major etiologic importance. The use of calcium ion combining gels with a low phosphatic diet has not been found to be particularly beneficial in the paraplegic with calculi. The same statement may be applied in the use of hyaluronidase for the prevention of recurrence, or for dissolution of renal calculi in the paraplegic. Infection may be combatted by the forcing of fluids and the use of chemotherapeutic preparations over a period of months, with rest periods every few weeks. Antibiotic preparations should only be used in the paraplegic who develops a febrile episode due to urinary tract infection that does not respond to the chemotherapeutic preparations.

Bladder Calculi.—The incidence of the formation of the "egg shell" type of calculi is high, and in many patients this type of stone will not be seen on x-ray. A patient who has signs of bladder irritability should have a visual inspection of the bladder. The large majority of vesical calculi may be removed with a Lowsley grasping forceps introduced through a resectoscope sheath. Larger calculi are removed as described in Chapter XXV (Surgical Approach to the Bladder).

branches of the lateral sacral artery are encountered. These branches must be cauterized. The sacral foramina are enlarged with a punch, both medially and superiorly. Care is taken not to enter the dural sac. The nerve can easily be grasped with a nerve hook, and should be pulled clearly into view to avoid possible injury to the rectal wall The nerve is then severed between two silver clips. Gelfoam is inserted in the sacral foramen. As many nerves are cut as has been determined preoperatively by Novocain injection. Closure is performed in individual layers with interrupted sutures of medium and fine black silk "

In carrying out differential sacral block in twenty-five patients, we have noted that the third sacral is the principal nerve involved in micturition Only those patients who under the influence of differential Novocain block show increase in bladder capacity, decrease in bladder and sphincter tone, and ability to void automatically with little or no residual urine should be selected for sacral neurectomy. Bowel and sexual function may be improved following the procedure.

Transurethral Resection of the Bladder Neck.—In 1935, Braasch and Thompson first advocated resection of the hypertrophied or spastic vesicle neck in the imbalanced bladder. Subsequently, Emmett described a balance of power existing between opposite forces, namely the detrusor for expelling urine and the obstructive urethral orifice resisting the expulsion of urine. Although there is still a difference of opinion as to the presence of a true, mechanical obstructing factor, Orr et al. state that the elimination of the urethral orifice resistance by resection is due to destruction of the nerve endings There can be little doubt that a high percentage of patients are benefited by resection, whether it be due to the removal of true hypertrophied tissue or to elimination of spasm of the internal orifice

Transurethral resection is carried out under Pentothal anesthesia, although sensation may not be present After gentle dilatation of the urethra, a No. 24 F. resectoscope sheath is introduced, followed by the working element Late complications of hemorrhage and infection are minimized by using a high cutting current with spot fulguration of bleeding points. Multiple pieces of tissue are removed, beginning in the base distal to the ureteral meatuses. Resection is continued around the entire circumference of the bladder neck in an attempt to remove the entire bladder neck and not to remove a wedge or carry out a "tenotomy," as some have advocated. Resection must be carried down to the verumontanum, as removal of the bladder neck alone may result in obstruction from a minimal amount of tissue near the veru made prominent by resection of the bladder neck Tissue fragments are evacuated from the bladder and a No. 16 F. Foley catheter is left indwelling for three to seven days, after which time the patient is given a voiding trial. Repeated resections are at times necessary It is not necessary that obstruction be observed at the time of cystoscopy. A persistently high residual urine with cystometric recordings of efficient detrusor activity provides sufficient indication for operative intervention. The over-all results have been excellent in those who have

changes probably take place because of the formation of trabecular bands which form in all patients with neurogenic bladder and are present in severe, chronic infection or obstruction at and below the bladder neck.

John A. Hutch, while a member of our urological staff, devised an operative procedure designed to correct this defect. The operation has three principles: first, the attachment of the ureter to the trigone is preserved; second, a long, intravesical ureter is constructed; and third, the postulated defect in the bladder wall under the intravesical ureter is repaired. Prior to the development of this procedure, re-implantation of the ureter had been unsuccessful in our hands. The procedure to be described has prevented reflux in 22 of 25 patients, with no recurrences up to a period of 4 years following surgery.

Fig. 362.—The intravesical ureter is freed from the detrusor fibers except in the region of its attachment to the trigone. The defect in the bladder wall is closed under the newly created intravesical ureter. An anchor suture is taken between the wall of the ureter and the bladder.

Operative Procedure.—Preoperatively a No. 6 polyvinyl ureteral catheter is passed cystoscopically and after the patient has been given an inhalation anesthesia a midline suprapubic or Cherney transverse incision is made and the bladder exposed. The peritoneum is reflected upward from the anterior surface of the bladder and medially from the lateral abdominal wall. There the distal one third of the inverted ureter is exposed. The ureter is then dissected downward until it can be seen disappearing into the bladder wall. The dissection of the ureter is carried on through the bladder wall on the ventral and lateral surfaces (Fig. 362).

Suprapubic Instrumental Litholapaxy.—Calcareous material or stones can be removed through the well-established suprapubic sinus by cystoscopic instruments. Lowsley utility forceps and the McCarthy panendoscope are useful for this purpose. The suprapubic catheter is removed and the panendoscope inserted. If anesthesia is necessary, 2 per cent procaine is injected superficially into the sinus wall, and 30 c.c. of the solution is instilled in the bladder. After 10 to 12 minutes, the panendoscope is inserted and the stone identified. The bladder is then washed free of exudate. The Lowsley forceps are next inserted and the calculi crushed under direct vision. It may be necessary to use the panendoscope intermittently for irrigation, to ensure good visualization. The concretions are usually friable. The fragments are then removed instrumentally. Care must be taken to avoid injury of the mucosa with the jaws of the forceps. The fragments should be small enough to pass through the sinus tract without severe abrasions of the granulation tissue. The suprapubic catheter is reinserted, and irrigated after turning the patient completely onto his abdomen. Small particles lying in the region of the trigone are thus removed. Surgical lithotomy can be frequently avoided in these cases.

Surgical Closure of Suprapubic Fistula.—Cystostomy wounds fail to close in some patients primarily because they have been improperly performed, the tract having been established just above the symphysis pubis. Other factors that may be present are the development of a fibrotic, epithelized tract, the presence of infection at all times, and a "neurogenic factor" coupled with a diminution in tonicity of the abdominal musculature. The seriousness of this complication was manifested to us when two deaths occurred on our service in which post-mortem examination in each revealed that only the distal portion of the sinus had healed and the unhealed, fibrotic barrier of the unobliterated justa vesical portion was overcome, resulting in fatal peritonitis by direct contiguity.

In repairing the fistulous tract, it is dissected out down to and including a cuff of the bladder, and the defect in the bladder wall is closed by interrupted chromic 0 catgut in two layers. The abdominal wall is closed in layers, using, in addition, a continuous mattress suture of fine stainless steel through the anterior rectus sheath. A No. 16 F. Foley catheter remains indwelling until the wound is well healed.

Plastic Repair of Vesicoureteral Reflux.—Probably the most serious of all complications involving the urinary tract in the paralyzed patient is vesicoureteral reflux. Of 17 deaths on our paraplegic service from urological causes, 9 were due to reflux and its complications. Although there has been a slight decrease in the incidence of reflux since the advent of antibiotics and more skillful surgical care, we have observed 110 patients with reflux in a total of 854 cord injury or disease patients admitted to our hospital since April, 1946, an incidence of 12.8 per cent.

Vesicoureteral reflux in the paraplegic is probably the result of anatomical changes which take place around the ureteral orifice, resulting in a loss of supporting musculature behind the intravesical ureter. These anatomical

changes probably take place because of the formation of trabecular bands which form in all patients with neurogenic bladder and are present in severe, chronic infection or obstruction at and below the bladder neck

John A Hutch, while a member of our urological staff, devised an operative procedure designed to correct this defect The operation has three principles first, the attachment of the ureter to the trigone is preserved, second, a long, intravesical ureter is constructed, and third the postulated defect in the bladder wall under the intravesical ureter is repaired Prior to the development of this procedure, reimplantation of the ureter had been unsuccessful in our hands The procedure to be described has prevented reflux in 22 of 25 patients with no recurrences up to a period of 4 years following surgery

Fig 362 —The intravesical ureter is freed from the detrusor fibers except in the region of its attachment to the trigone The defect in the bladder wall is closed under the newly created intravesical ureter An anchor suture is taken between the wall of the ureter and the bladder

Operative Procedure—Preoperatively a No 6 polyvinyl ureteral catheter is passed cystoscopically and after the patient has been given an inhalation anesthesia a midline suprapubic or Cherney transverse incision is made and the bladder exposed The peritoneum is reflected upward from the anterior surface of the bladder and medially from the lateral abdominal wall There the distal one third of the inverted ureter is exposed The ureter is then dissected downward until it can be seen disappearing into the bladder wall The dissection of the ureter is carried on through the bladder wall on the ventral and lateral surfaces (Fig 362)

The bladder is then opened either longitudinally or in a transverse direction, exposing the plastic ureteral catheter as it disappears through the ureteral orifices. The bladder mucous membrane is then incised along the course of the intramural ureter and the dissection of the intramural ureter is then completed in such a manner that the entire intravesical ureter is freed from the detrusor fibers except in the region of the attachment of the ureter to the trigone. A small Babcock clamp is used to pull two to three centimeters of the ureter into the bladder. The defect in the bladder wall which was produced by the dissection of the intramural ureter is closed under the newly created intravesical ureter with two to four 0 chromic catgut sutures. These sutures should include the bladder mucosa and muscularis An anchor suture

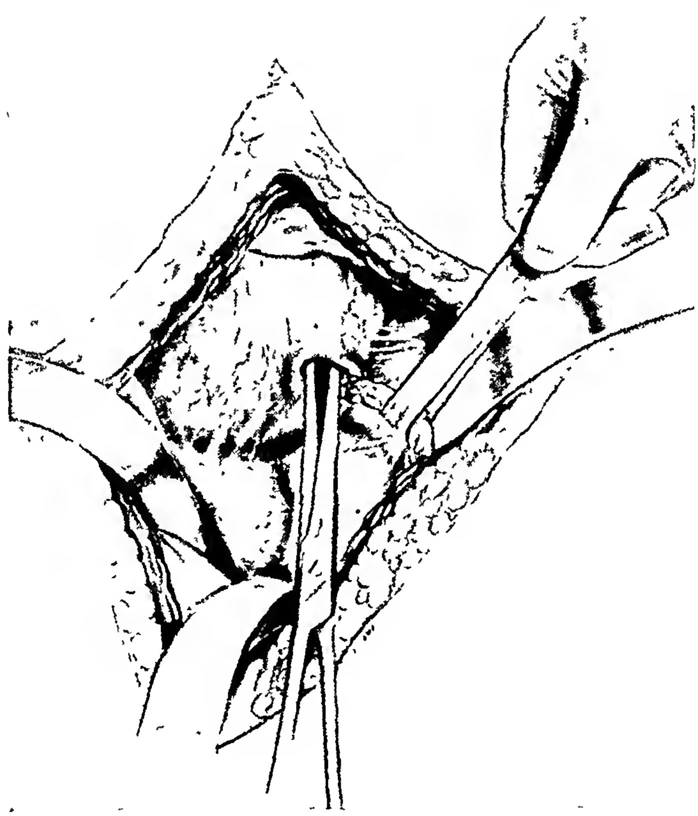

Fig 363—The ureter, after exposure in its lower third, is dissected downward until it can be seen disappearing into the bladder wall Dissection is carried on through the bladder wall on the ventral and lateral surfaces

of 0000 chromic catgut is then taken between the wall of the ureter and the bladder at the point where the ureter disappears into the bladder wall (Fig. 363) The defect on the outside of the bladder which was created during the dissection of the intramural ureter and partially closed from within the bladder is reinforced with several 0 chromic sutures, taken through the muscularis and serosa. The incision in the bladder and the wound are then closed in the usual manner after drains have been placed in the region of the lower ureter and in the space of Retzius. A No. 18 F. Foley catheter is passed into the

bladder through the urethra and left indwelling The urethral catheter is tied to the Foley catheter for stabilization The drains are removed on the second or third day and the ureteral catheters on the fifth to seventh day The urethral catheter remains indwelling until healing is satisfactory, at which time cystograms and excretory urograms are made

Complications of the External Genitalia—*Epididymitis* is of very common occurrence if drainage is by urethral catheter Treatment is as given elsewhere in this text Suprapubic drainage may prevent a large majority from developing epididymitis but is not necessary once the infection has developed

Periurethral abscess may be prevented to a large extent by using a small caliber catheter with the penis and catheter taped back on the abdomen Many may subside but some need early incision and drainage

Urethral fistulas are of common occurrence following periurethral abscesses and may be prevented by the early incision and drainage of these abscesses Some may heal spontaneously, others may close after simple fulguration or curettement Occasionally, it is necessary to close the fistula as described in Chapter XXXIII (Surgical Treatment of Strictures and Fistulas of the Male Urethra)

Urethral diverticula were seen very frequently following World War II The incidence in 402 patients seen by us up until January, 1949, was 13 4 per cent With the use of smaller catheters, antibiotic preparations, and improved care by experienced personnel, the incidence has been reduced to 2 3 per cent in the last 450 patients treated by us since January, 1949 Diverticula of the male urethra in the paraplegic follow the destruction of the urethral wall by infection

Nonoperative management may be attempted by instructing the patient to carry out manual compression of the sac to prevent stagnation Various irrigating solutions may be instilled into the diverticulum and antibiotics should be prescribed for their local and systemic effect

In the operative management of the diverticulum some have advocated transurethral enlargement of the neck by fulguration or resection This does not eliminate the basic anatomical alterations that have occurred and surgical repair is indicated After preliminary diversion of the urinary stream, preferably by means of perineal urethrostomy, diverticulectomy is carried out as described in Chapter XXIX

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CHAPTER XXIX

THE SURGICAL TREATMENT OF PATENT URACHUS, CYSTS OF URACHUS, EXSTROPHY OF BLADDER AND DIVERTICULA OF THE BLADDER

PATENT URACHUS AND URACHAL CYST

In normal development that portion of the allantois leading from the apex of the bladder to the umbilicus is reduced to a small, solid cord known as the urachus. Occasionally the urachus remains patent either in part or throughout its entire length. Complete patency is rare and usually associated with congenital obstruction of the bladder. Either end may fail to close, leaving a persistent tube which communicates with the bladder or opens at the umbilicus, or both ends may become obliterated, leaving an unobliterated midportion which frequently becomes dilated to form a cyst.

Diagnosis.—Complete patency is very rare; it is recognized by the appearance of urine at the navel. The usual symptoms of bladder obstruction are present. An opening at the umbilicus produces a thin, mucoid discharge which often causes considerable irritation of the surrounding tissues. The sinus can be demonstrated by passing a small probe. When the partially obliterated urachus opens into the bladder it is usually unrecognized. If obstruction of the bladder develops it may become dilated, simulating a diverticulum.

Urachal cysts result from the secretory activity of the lining membrane of the unobliterated midportion. They usually present a tubular mass in the midline of the abdomen below the navel. Occasionally the cysts grow to considerable size and present the appearance of an abdominal tumor. Such a cyst was removed by J. Shelton Horsley from a four-year-old boy. The child's mother stated that his abdomen had been large all his life but had increased in size during the three months just before entering the hospital. Three days before admission to the hospital he complained of abdominal pain and his mother found a mass in the left side of his abdomen. At operation the cyst was found strongly attached to the navel and to the fundus of the bladder. The specimen consisted of a cystic growth 17 cm. in diameter, weighing 751.27 grams (Fig. 364).

Infection of the cyst often calls attention to its presence. The mass is tender and painful and may be accompanied by gastrointestinal disturbances. The infected cyst occasionally ruptures into the bladder, causing severe cystitis.

Treatment.—Complete excision of the urachus is necessary. In the case operated upon by Horsley a long incision was made through the left rectus muscle. When the abdominal cavity was opened, a transverse incision was made through the parietal peritoneum just above the navel and the growth carefully

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of the pubic bones The mortality is quite high, resulting from associated deformities or kidney infection If the individual is not operated upon and lives to middle age, carcinoma of the bladder is a frequent complication

Treatment —During infancy the strictest cleanliness should be observed Excoriation of the mucous membrane may be minimized by the use of oiled gauze next to the surface or the liberal use of white petroleum jelly Plastic operations to close the defect and restore bladder function are usually unsatisfactory It is rarely possible to obtain even partial control of the urine The ureters should be transplanted into the large bowel (Chapter XXIII), the exstrophied bladder removed, and the deformity of the external abdominal wall and genitals corrected by plastic operations (Figs 421 424)

DIVERTICULA

Diverticula of the bladder probably develop because of some congenital defect in the wall of the bladder Of 151 cases reported by Lower 62 1 per cent were on the lateral walls of the bladder just external to the ureteral orifices The longitudinal muscle fibers are not so abundant in this area and, as mentioned by English, the wall of the bladder here is weakened by the insertion of the ureters They occur next in frequency on the posterior wall of the bladder but may be found in any area Regardless of predisposing factors, diverticula are with few exceptions recognized clinically in association with obstruction at the bladder orifice (Fig 365) or in the urethra The influence of obstruction is well illustrated by the relative infrequency of diverticula in the female and in children Of 100 cases reported by Kutzmann only three were in women and 91 were recognized after 50 years of age Day and Martin report 69 cases, in which fibrous contracture of the bladder orifice was present in 42 and hypertrophy of the prostate in 25 In one case diverticula accompanied stricture of the urethra in a woman and in one the obstructive lesion was a congenital valve Young states that the congenital cases probably result from prenatal obstruction

Complications —In addition to obstruction, which is a causative factor in most diverticula, the most frequent complications are infection, stone, and tumor Infection is a common complication of all obstructive lesions of the urinary tract Large diverticula may never completely empty themselves, particularly when obstruction is present at the bladder outlet Infection is most severe when the orifice to the diverticula is small Not infrequently persistent pyuria following prostatectomy is caused by infection in a diverticulum that has been overlooked

The stagnation of urine and the presence of infection in cases of diverticula are particularly conducive to the formation of stones Stones may be found in the diverticulum, in the bladder, or in both In some cases dumbbell types of stones are found growing partly in the bladder and partly in the diverticulum Occasionally a stone completely fills a small diverticulum and when the orifice is small the stone is rather difficult to locate and to remove A case came under my observation in which three stones apparently in the bladder were found to occupy separate diverticula Of 157 cases of diverticula reported by Lower stones were present in the bladder or the diverticulum in twenty seven

dissected off from the navel. The end of the growth was incorporated into the fundus of the bladder and so this portion of the bladder was excised. The wound in the bladder was closed and a catheter was inserted through the urethra and fastened in place for continuous drainage.

If the cyst becomes infected, the operation must be done in two stages. First the cyst is widely opened and drained or packed with an antiseptic dressing. When the inflammation has completely subsided, the entire tract is dissected free and removed.

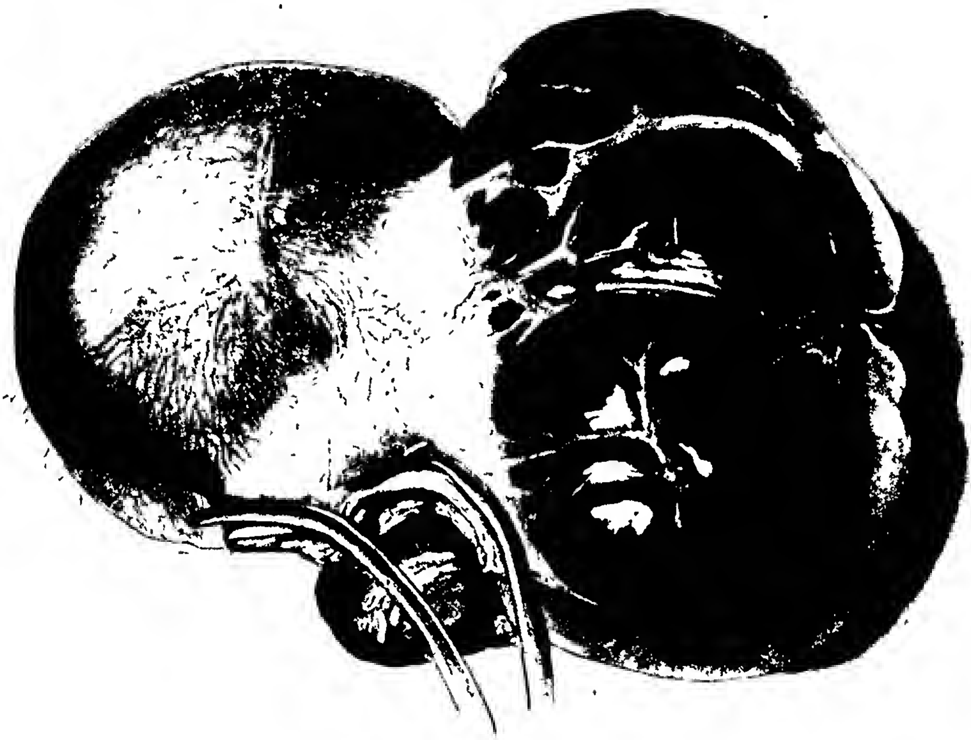

Fig 364 —Cyst of the urachus removed from a child four years old

EXSTROPHY OF THE BLADDER

Exstrophy of the bladder is a congenital anomaly in which there is an absence of the anterior bladder wall associated with a fissure of the anterior abdominal wall and complete epispadias The cutaneous margins of the abdominal defect are continuous with the mucous membrane of the bladder. There are diastasis of the abdominal muscles and separation of the pubic bones In the male undescended testicles and inguinal hernia are not uncommon. In the female the clitoris is cleft and the labia are widely separated The internal genitals are usually normal.

The condition is readily recognized at birth as a moist, red, protruding area just above the pubis. On close inspection jets of urine can be seen coming from the ureteral orifices. As the child grows older, the chief complaint is incontinence of urine. The individual has a clumsy, waddling gait because of the separation

Diagnosis—Diverticula are usually recognized during a routine urological examination of patients complaining of disturbances of bladder function The patient who voids again within a few minutes after having apparently emptied his bladder should be suspected of having a diverticulum but the same thing may occur as a result of prostatic hypertrophy Frequency, difficult urination, and retention of urine are most frequently mentioned in case reports Pyuria and hematuria are also often noted These manifestations are usually due to the obstructive process and the associated infection A diverticulum without infection or advanced obstruction may not cause any noticeable inconvenience

In most cases diverticula are recognized during cystoscopic examination, especially in cases of bladder neck obstruction The cystoscopic study rarely determines the exact size of a diverticulum nor is it often possible to locate stones or tumors within the sac The diagnosis must be completed by x ray studies including a cystogram The cystogram will show the size of a diverticulum and its relation to the bladder which is very important if operation is to be done (Fig 70) Cystograms should always be made in cases of prostatic hypertrophy when cystoscopy is contraindicated or cannot be accomplished The orifices of diverticula are often quite small and may be overlooked when the bladder is opened, furthermore, pathological conditions are much more satisfactorily dealt with when an accurate diagnosis is made previous to operation In cases of diverticula the examination should include the kidneys and the ureters An intravenous urogram is a valuable means of evaluating the pathological changes that the bladder lesion may have caused in the kidneys The relation of the ureteral orifices and ureters to the diverticulum should be determined as accurately as possible A roentgenogram with nonopaque catheters in the ureters and another coiled in the diverticulum will give a fairly accurate idea of this relationship

Treatment—Of first importance in the treatment of diverticula is the removal of obstruction to bladder drainage When this obstruction has been relieved many diverticula, especially when small and with large orifices, will be relieved of retention and will cause no further trouble In large diverticula the retention will be greatly reduced but drainage is rarely complete The infected residual urine retards healing and prevents a return to normal bladder function even when the obstruction has been completely relieved

If the obstruction is to be treated by transurethral methods or by perineal prostatectomy, it is better to remove the obstruction first and to reserve surgical treatment of the diverticulum for those cases in which satisfactory drainage is not obtained The patient's general condition and kidney function will improve, but if the diverticulum continues to be a source of infection or retention it should be removed If suprapubic prostatectomy is to be done large diverticula should be removed as a preliminary operation Suprapubic prostatectomy greatly increases the difficulty of a subsequent diverticulectomy because of scar tissue and prevesical adhesions, and in most patients requiring prostatectomy removal of the diverticulum at the same time is too great a hazard

Tumors occur rather rarely in diverticula. LeComte collected 40 cases from the literature and added one of his own. In Lower's series tumor was associated with diverticulum in eight cases, in two of which the tumor was in the diverticulum.

Diverticula occasionally rupture either spontaneously or from trauma. R. L. Creekmur reported a case of spontaneous rupture of a diverticulum. The patient was operated upon and recovered. Several years later he came under my observation because of a median bar, which proved to be associated with a tuberculous prostate.

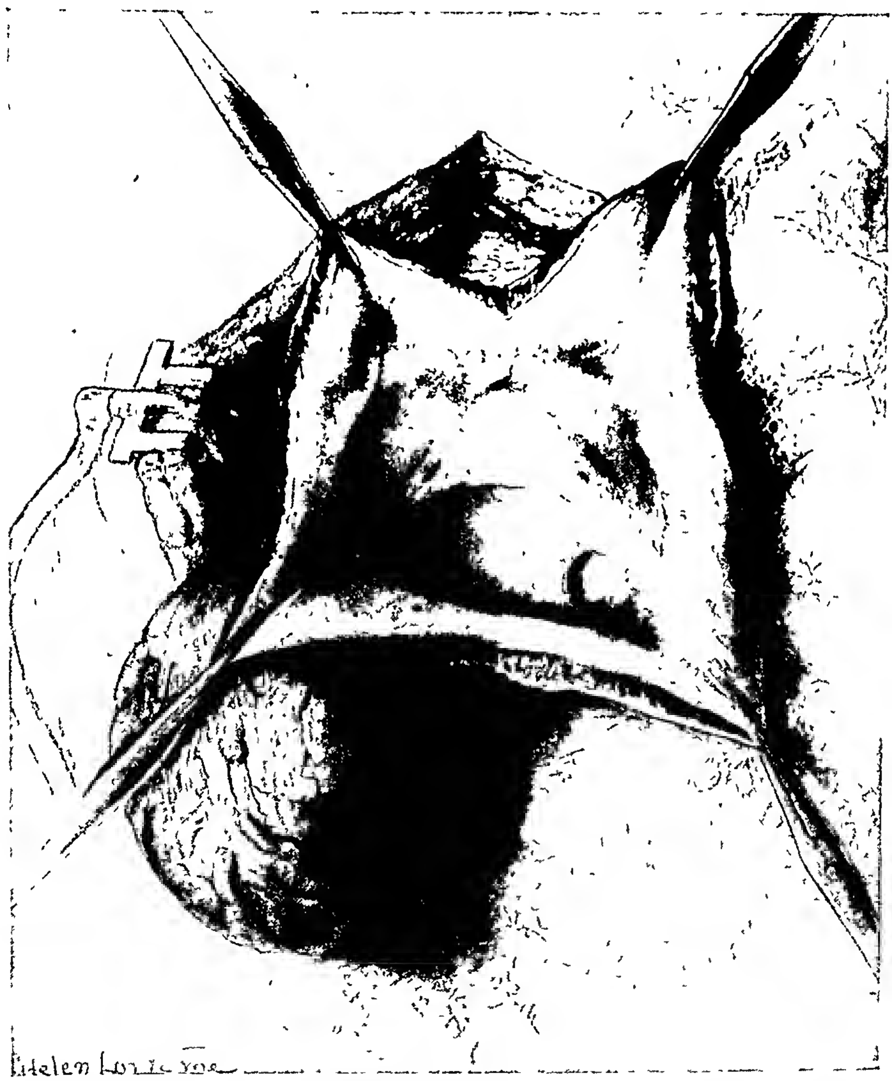

Fig 365.—Diverticulum of the bladder with stenosis of the bladder orifice and hypertrophy of the trigone The patient, 27 years of age, gave a history of difficult urination since childhood

Diverticula occasionally cause obstruction of one or both ureters. The ureteral orifice may be drawn into the diverticulum or the course of the ureter may be changed by pressure. In either case hydroureter and hydronephrosis may ensue This condition also encourages renal infection

Diagnosis.—Diverticula are usually recognized during a routine urological examination of patients complaining of disturbances of bladder function. The patient who voids again within a few minutes after having apparently emptied his bladder should be suspected of having a diverticulum but the same thing may occur as a result of prostatic hypertrophy. Frequency, difficult urination, and retention of urine are most frequently mentioned in case reports. Pyuria and hematuria are also often noted. These manifestations are usually due to the obstructive process and the associated infection. A diverticulum without infection or advanced obstruction may not cause any noticeable inconvenience.

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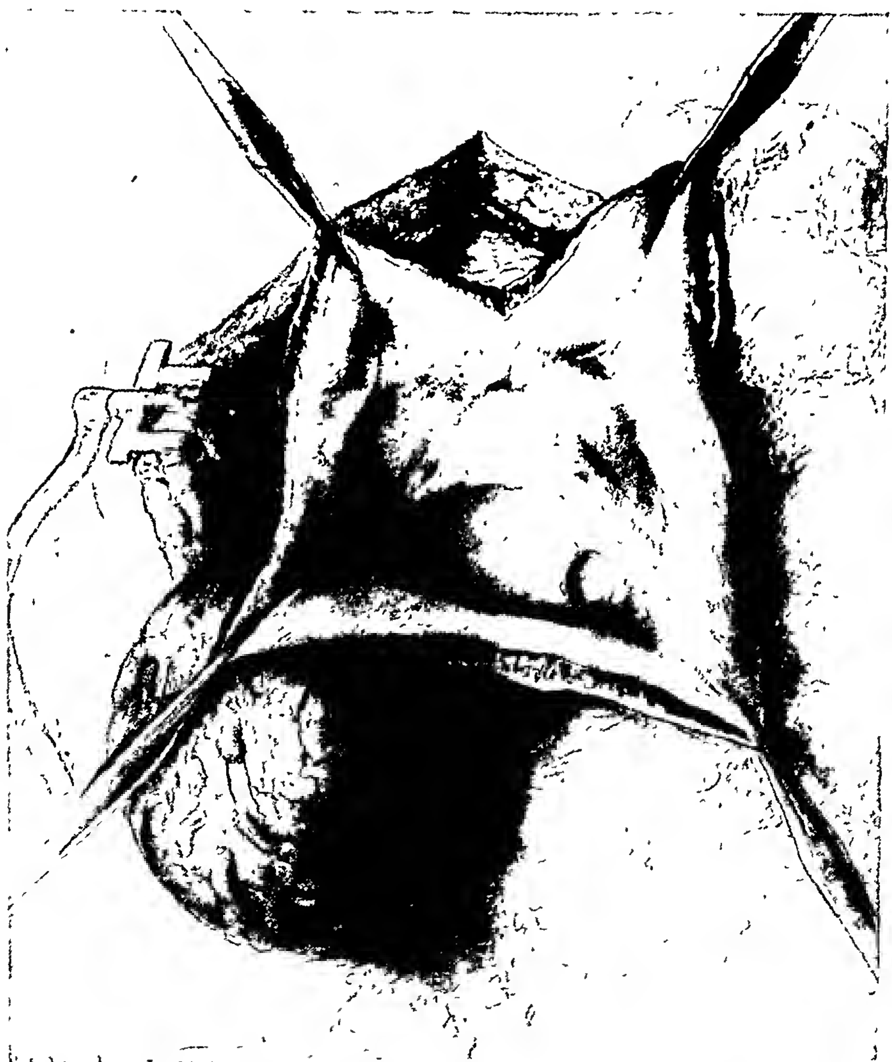

Fig 365.—Diverticulum of the bladder with stenosis of the bladder orifice and hypertrophy of the trigone The patient, 27 years of age, gave a history of difficult urination since childhood

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through the neck of the diverticulum and gradually withdrawn as the wall of the pouch is sucked up into the tube Or the wall of the diverticulum may be caught with forceps and gradually pulled into the bladder (Fig 366) When eversion is complete, an incision is carried around the neck of the pouch through the mucosa, submucosa and into the fibrous layer, taking care to avoid the ureter (Fig 367) If the ureter opens into the diverticulum, a V shaped flap is made around its orifice The closure will leave the ureter opening into the bladder in a normal manner After the incision has been completed around the neck of the diverticulum, the mucosa, submucosa and a portion of the fibrous coat are dissected off, chiefly with dry gauze but using a knife or scissors to cut bands of adhesions when necessary All bleeding points are carefully clamped

Fig 367 —The diverticulum has been completely inverted The dotted line indicates the incision for its removal

and ligated When the dissection is complete, the tissue that has not been removed is returned through the diverticular opening The cavity from which the diverticulum has been removed is explored with the finger to be sure the peritoneum has not been opened A cigarette drain is carried from the prevesical space into the cavity left by the diverticulum and the defect in the bladder wall is repaired by continuous sutures of chromic catgut (Figs 368 and 369)

When it is difficult to invert the sac into the bladder Young makes a circular incision around the orifice of the diverticulum and after locating a line of cleavage gradually dissects the lining from the diverticulum and draws it into the bladder

DIVERTICULECTOMY

For this operation, as in all extensive operations upon the bladder, spinal anesthesia is usually preferred. The bladder is thoroughly irrigated and is filled with a mild antiseptic solution The catheter is clamped and left in the urethra to aid in emptying the bladder after it is exposed. With the patient in moderate Trendelenburg position the bladder is exposed by a suprapubic extraperitoneal incision. The anterior wall of the bladder is then grasped with Allis forceps, the clamp is removed from the indwelling catheter, and the bladder is permitted to empty. The diverticulum may be removed extravesically or from within the bladder by the method described by H. H. Young. The intravesical method simplifies the operation considerably when dealing with small diverticula but

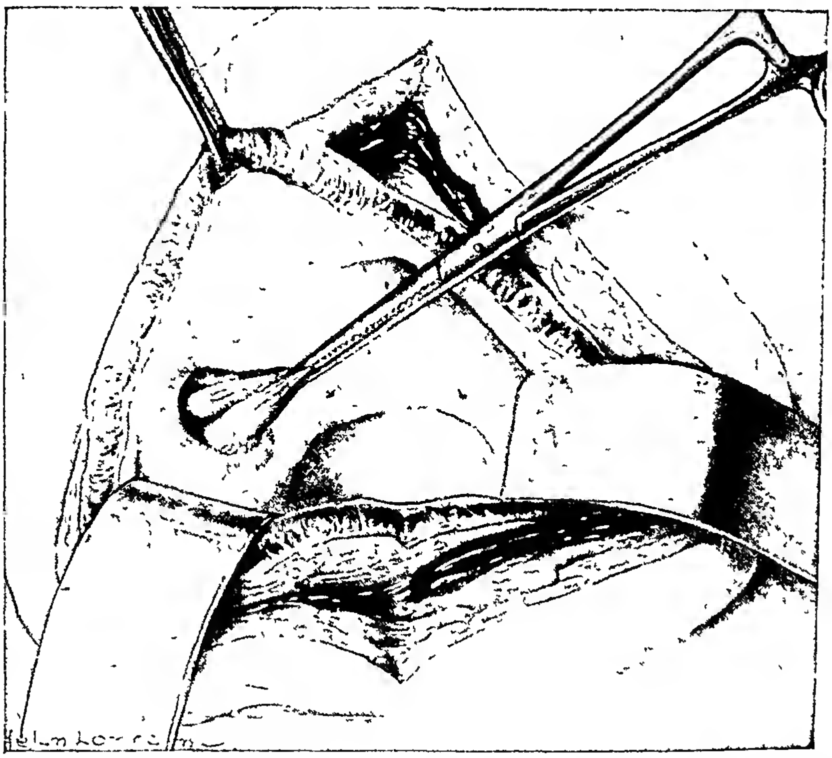


Fig 366—The bladder is being held open by large ribbon retractors The wall of the diverticulum is grasped with a hemostat or tenaculum and gradually pulled into the bladder

when the pouch is very large the extravesical approach is preferred by most surgeons It is not necessary to remove all of the diverticulum to effect a cure. If the entire mucous membrane is removed and the cavity drained, complete relief will be obtained Recently Edward L Peirson and Roger W. Barnes have independently described an identical procedure for excising the mucous membranes of large diverticula extravesically.

Regardless of the method of excision the bladder should be opened in the median line anteriorly and the position and extent of the diverticulum verified. The method of excision best suited to the case is then employed.

In the operation devised by Young the pouch is drawn into the bladder by a large glass tube attached to a suction apparatus. The glass tube is inserted

When the diverticulum is large or when it is adherent, it is more satisfactory to dissect it externally. After opening the bladder widely through the prevesical space and protecting the prevesical space with gauze packing, the diverticulum is explored with the finger. It may be packed with gauze to identify it or, with one or two fingers in the diverticulum, dissection is carried through the prevesical tissues to the sac, which is lifted up by the fingers within it. If the sac is covered by peritoneum the peritoneum may be opened, though usually this is not necessary. The vas deferens and the ureter must be identified and injury to these structures avoided. Occasionally the ureter is involved in the diverticulum and it may be necessary to divide it and reimplant it into the bladder. When the sac has been completely freed the internal relation of the neck of the sac

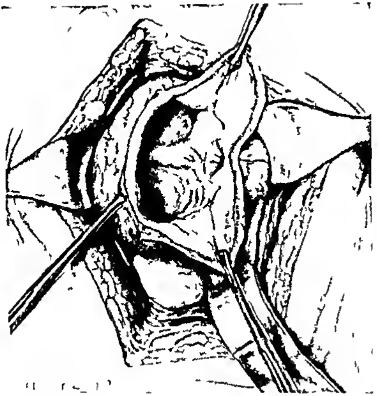


Fig. 371.—The orifice of the diverticulum is exposed. The dotted line indicates line of incision through the bladder mucosa. The bladder incision is extended on the wall of the diverticulum to the mucosa for a short distance.

to the ureter is noted and the diverticulum is then cut away. The opening in the bladder is closed as after operations for tumors. The suprapubic opening is sutured except for a drainage tube which comes out at the upper part of the bladder wound near the peritoneal fold. A cigarette drain is carried down through the prevesical space to the site of the old diverticulum.

The operation described by Pearson consists in removing the mucosal lining from the fibrous sac through an incision in the superior lateral aspect of the diverticulum. After opening the bladder suprapubically a finger is passed from the bladder into the diverticulum, and the lateral wall of the bladder and the

Fig 368

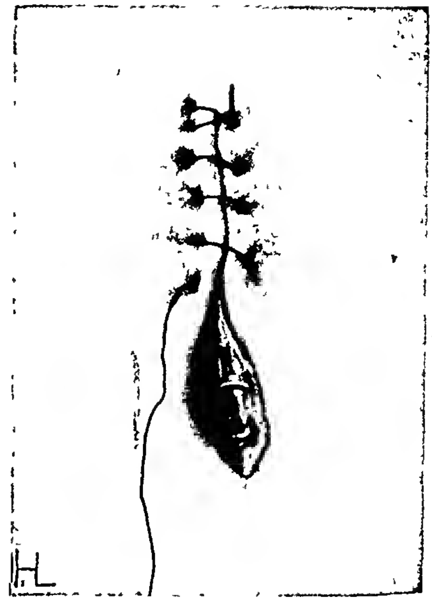


Fig 369

Fig 368 —After the diverticulum has been excised the wound is closed by two layers of sutures The first, of No 1 chromic catgut, includes the muscle and fibrous layers of the bladder wall

Fig 369 —The second layer of sutures, of No 00 chromic catgut, closing the mucous membrane of the bladder

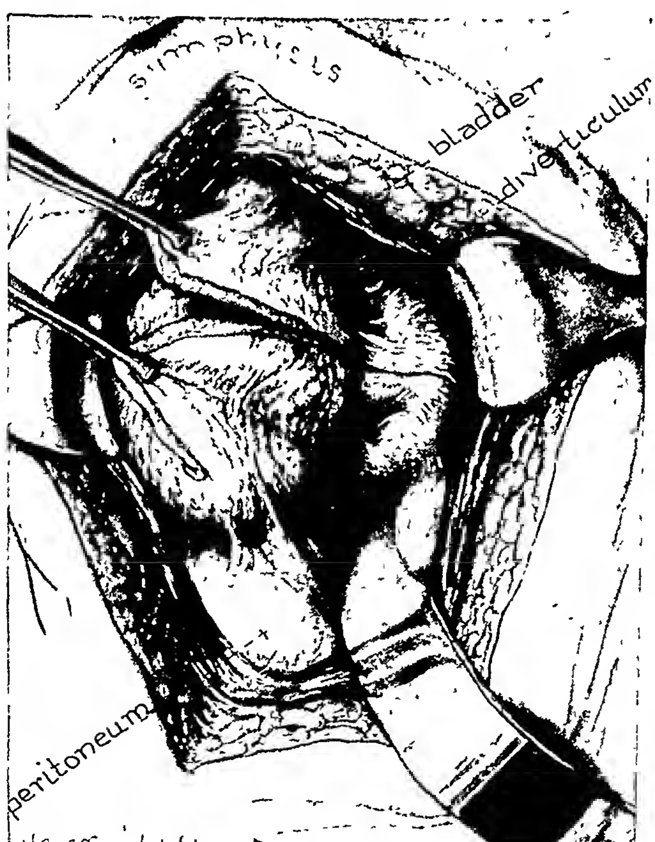
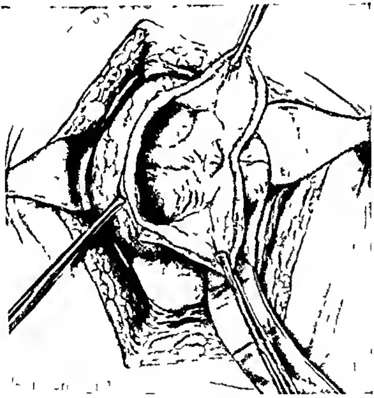


Fig 370 —Excision of large diverticulum of the bladder by the method described by Edward L Peirson The bladder is exposed and opened suprapubically The bladder is then incised from the suprapubic opening to the orifice of the diverticulum

When the diverticulum is large or when it is adherent, it is more satisfactory to dissect it externally. After opening the bladder widely through the prevesical space and protecting the prevesical space with gauze packing, the diverticulum is explored with the finger. It may be packed with gauze to identify it or, with one or two fingers in the diverticulum, dissection is carried through the prevesical tissues to the sac, which is lifted up by the fingers within it. If the sac is covered by peritoneum the peritoneum may be opened, though usually this is not necessary. The vas deferens and the ureter must be identified and injury to these structures avoided. Occasionally the ureter is involved in the diverticulum and it may be necessary to divide it and reimplant it into the bladder. When the sac has been completely freed the internal relation of the neck of the sac



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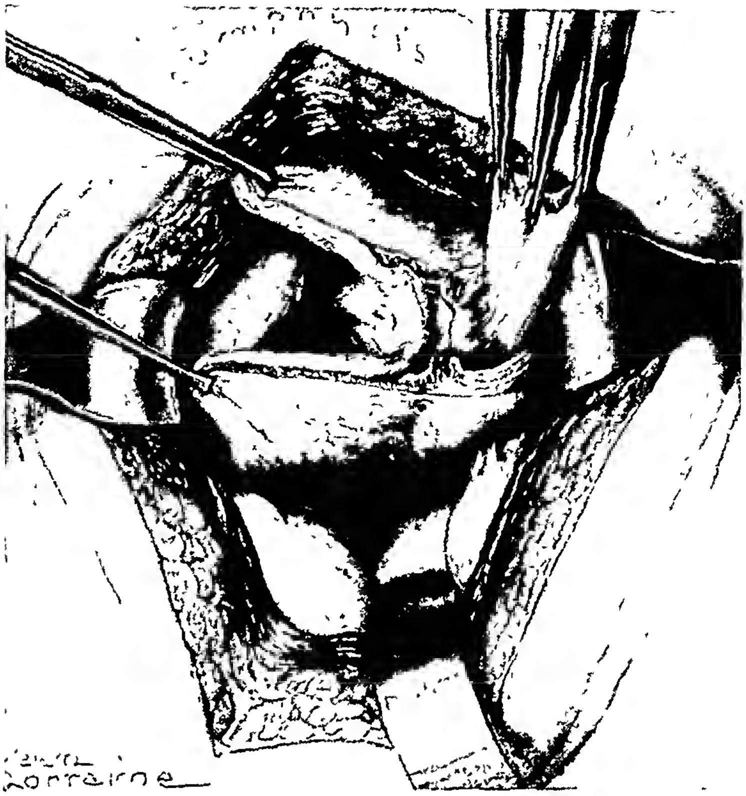

Fig 372—The mucous membrane of the diverticulum including a cuff of bladder mucosa rounding the orifice of the diverticulum, is removed

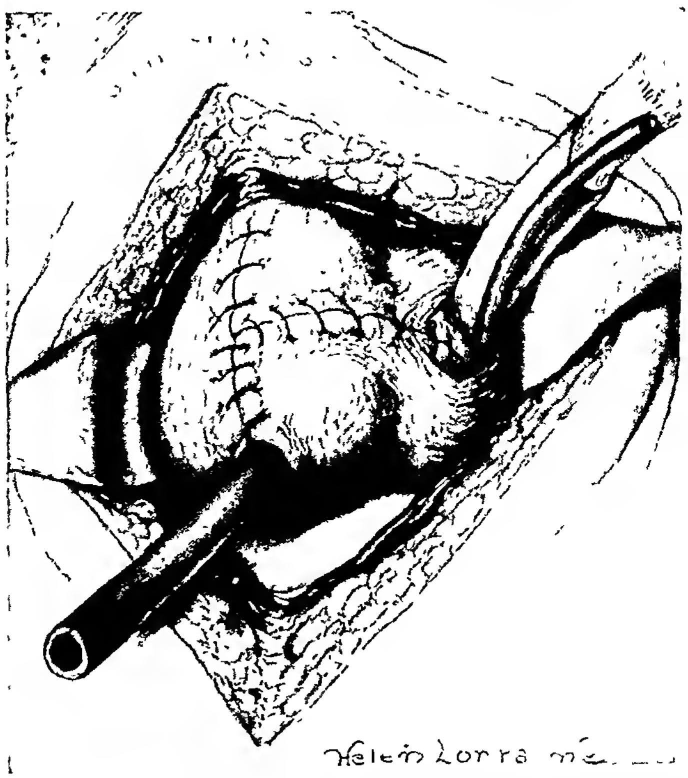

Fig. 373—Drainage is placed in the fibrous pocket left by excising the mucous memb of the diverticulum and the bladder is closed A tube is place in the upper angle of

superior lateral aspect of the diverticulum are exposed by dissecting away the peritoneum and loose perivesical tissues. A lateral incision may then be made in the bladder wall extending from the median incision along the superior lateral aspect of the diverticulum. The incision in the diverticulum is carried down to the mucosa (Fig 370). The dissection of the mucosa is begun by making a circular incision through the mucosa at the orifice of the diverticulum (Fig 371). After a line of cleavage is found, the mucosa strips off without difficulty. As the dissection progresses the bladder is pulled toward the opposite side. The incision is extended sufficiently to give adequate exposure inside the diverticulum and the mucous membrane is completely separated by blunt dissection (Fig 372). This exposure makes removal of the mucous membrane of a large diverticulum much easier than in the intravesical method. The bladder is closed, beginning within the denuded diverticulum at the lower end of the incision, and a drain is placed within the denuded cavity of the diverticulum (Fig 373). The median bladder incision is closed with a tube placed near the upper angle for drainage of the bladder. If the diverticulum is easily accessible the incision may be made directly to the diverticulum and the dissection carried out without opening the bladder. A puncture wound is made in the bladder for suprapubic drainage, the diverticular orifice is closed from within the denuded cavity and the cavity is drained. This method of treating large diverticula gives complete cure without the dangers of injuring contiguous structures that attend entire removal of the fibrous wall of the sac.

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CHAPTER XXX

TUMORS OF THE BLADDER, GENERAL CONSIDERATIONS

Tumors of the bladder are with few exceptions of epithelial origin and are predominantly malignant They are relatively rare, comprising less than 3 per cent of all tumors and about 4 per cent of all malignant growths found in the male. They are said to form 3 per cent of all urinary affections. The sex incidence in the majority of reports indicates that bladder tumors occur about four times as often in the male as in the female.

NONEPITHELIAL TUMORS

Nonepithelial tumors of the bladder are usually of mesodermal origin and are extremely rare. They are classified according to structure into fibromas, myomas, sarcomas, angiomas and tumors containing combinations of these structures There is no uniformity of opinion as to the etiology of these tumors. The sarcomas occur usually in childhood, the nonmalignant tumors at any age

These tumors may exist for a long time without causing symptoms, in fact, many of the cases reported have been discovered at necropsy. If they are situated at the ureteral orifice obstruction of drainage from the kidney may cause symptoms that require investigation, or the bladder orifice may be obstructed, causing retention of urine. In the case of a fibroma reported by Geisinger there was a history of occasional attacks of bladder irritation associated chiefly with menstrual periods over a period of several years These attacks characterized chiefly by night voiding and day frequency gradually became more severe, culminating in complete retention of urine.

In some cases the growth is first recognized as an abdominal tumor. A child four years of age that came under my observation gave a history of a return of bed-wetting, followed after a few months by day frequency and hematuria. An ulcerated sarcoma incrusted with calcium salts almost filled his bladder and could be readily palpated above the pubis (Figs 374, 375, and 376).

The diagnosis, as in other bladder lesions, is made by cystoscopic examination aided when necessary by x-ray examination including cystogram.

Treatment.—In the benign tumors the treatment is surgical. Small pedunculated growths have been removed through the cystoscope by using a snare to divide the pedicle. In most cases suprapubic cystotomy is necessary The tumor if submucous may be excised and the defect in the mucous membrane closed with a continuous suture of fine plain catgut. If the wall of the bladder is involved it is necessary to resect a portion of the bladder. The malignant tumors are rarely cured by any method of treatment. In the case

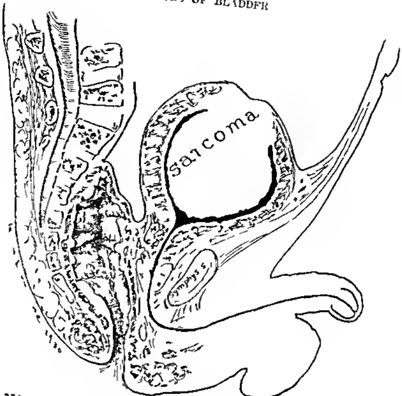

Fig 374—Sarcoma of the bladder in child four years of age

Fig 375—Sarcoma of the bladder (Fig 374) Specimen removed at operation The child died of metastasis six months later

of this child, the posterior wall of the bladder including the tumor was easily resected well beyond the margins of the growth and a thorough postoperative course of radiation was given but there was recurrence and death within six months Excision and irradiation are the treatment of choice in these tumors.

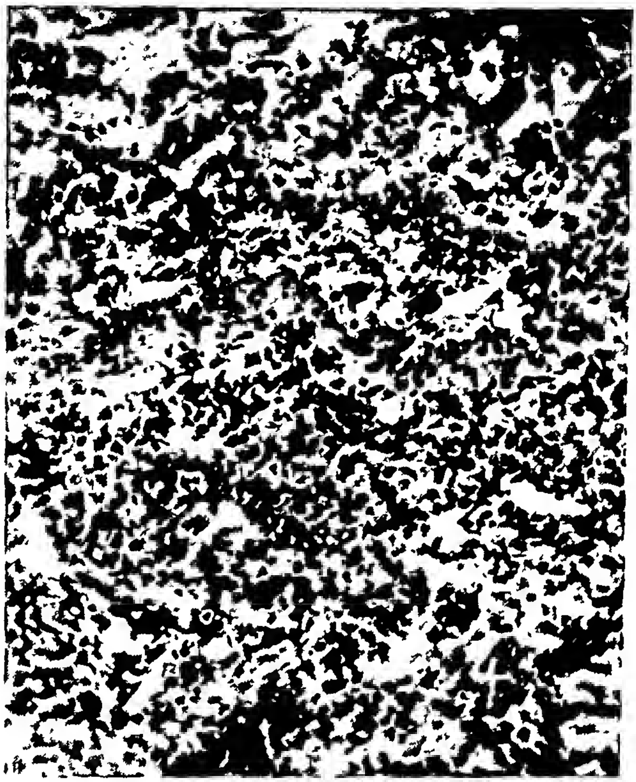

Fig 376 —Photomicrograph (reduced from ×250) of specimen seen in Fig. 375

EPITHELIAL TUMORS

Epithelial tumors of the bladder comprise a very small percentage of urological cases; yet they are so insidious in onset, so disturbing to bladder function, and so destructive to life that they occupy a prominent place in the attention of the urologist (Fig 377). In this chapter we shall discuss briefly the classification and clinical behavior of bladder tumors and call attention to the different methods of treatment The technique of surgical procedures and the principles of irradiation therapy will be discussed in greater detail in Chapter XXXI.

The etiology of any disease is of considerable importance in determining the treatment but in bladder tumors, as in other malignant growths, the sum of our knowledge as to cause is extremely limited. Some form of irritation seems to offer the most probable reason for their origin (Figs. 378 and 379). The occurrence of bladder tumors in a relatively large percentage of dye workers and in those affected with bilharziasis leads one to suspect that some irritating factor may operate in other types of bladder tumors also. Keyes and Ferguson state that the earliest lesion in the bladder appears to be a proliferation of the capillaries in the basal layer of the mucous membrane. They say that this observation

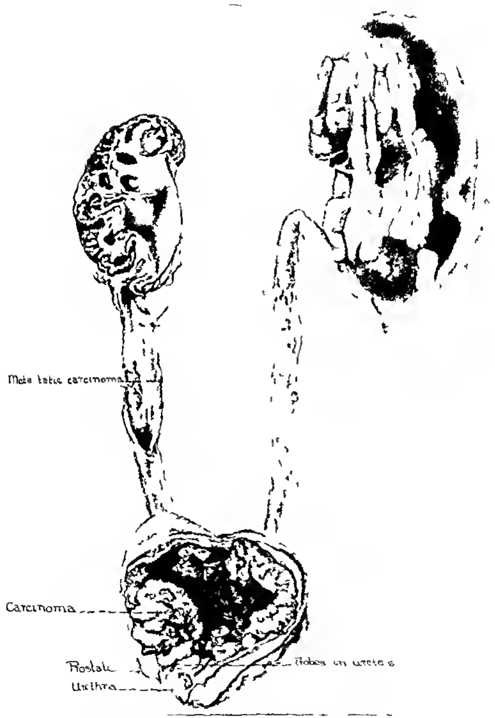

Fig 3 —Extensive papillary carcinoma of the bladder with metastasis to right ureter The patient died of bilateral pyonephrosis

Fig 378—Squamous cell carcinoma of the bladder apparently resulting from chronic irritation The patient had been treated for incrusted cystitis over a period of ten years before the tumor was recognized See Fig 379

Fig. 379—Chronic ulcers of bladder with calcium deposits over the entire bladder mucosa This patient developed squamous cell carcinoma in the ulcerated areas See Fig. 378.

has been made in acute cases of allantoin poisoning and cite Washburn's cases in which frank carcinoma developed later under the superficial layer of the epithelial lining of the bladder. They believe that the carcinogenic agent reaches the bladder through the blood stream. Keyes reports an interesting case in his practice in which an epithelial tumor developed sufficiently to be recognized while the patient was under observation for another condition. A small red area was noted behind the trigone, which six weeks later was covered with tiny papillary tumors.

J. E. Ash, discussing tumors of the bladder recorded in the Bladder Tumor Registry, believes that the term "recurrence" has been rather loosely applied and that recurrence at the site of a skillfully removed papillary tumor is unusual. He states that "recurrent tumors" are often new tumors that have formed in another part of the mucosa as a result of the same irritating factor that caused the original growth.

Age is an important factor in the occurrence of epithelial tumors of the bladder. Over 80 per cent of 22 741 patients recorded in the Tumor Registry were more than fifty years old. Very few tumors occurred before the fourth decade. In most reports the maximum number of tumors is found near the age of sixty. This is in keeping with the age factor in other epithelial tumors.

The male is much more frequently affected than the female. The ratio in the Tumor Registry cases is three to one. An even greater difference in sex incidence has been noted in other reports. The most plausible explanation of this discrepancy in sex incidence is the more frequent exposure of the male to irritating environment, especially in the industries. The male bladder is subject to more irritating factors than the female bladder, notably in advancing years, but tumors of the bladder are not particularly prevalent in cases of prostatic hypertrophy or vesical calculi.

Classification.—The physical characteristics of bladder tumors are of considerable importance in the choice of treatment. Elaborate classifications are of little clinical value. Keyes classifies bladder tumors into two groups, the papillary and the infiltrating, with the grade of malignancy estimated by the method of Broders. This simple classification gives a very clear understanding of the pathological characteristics and probable clinical behavior of the tumor.

The clinical behavior of bladder tumors cannot be predicted with certainty by the histologic picture. J. E. Ash after studying 2500 cases submitted to the Bladder Tumor Registry called attention to variations in cell structure in multiple papillary tumors and in different areas of the same tumor. J. A. C. Colston has made the same observation and believes that the cystoscopic appearance of the tumor is of more importance in determining the grade of malignancy than examination of the specimen obtained at biopsy. Archie L. Dean found that in 58 of 100 cases, microscopic examinations of specimens taken from the tumor removed at operation differed from biopsy specimens taken through the cystoscope. In at least half of all patients operated upon, the tumor was of a greater degree of malignancy than the cystoscopic biopsy had indicated.

Jewett and Blackman found that the degree of cell differentiation varied in different portions of the tumor in 55 per cent of 107 autopsy specimens Shivers and Henderson in a study of 101 cases found that of 32 cases of papilloma with a narrow pedicle no deaths had occurred from cancer. Of 35 cases with a broad pedicle more than a centimeter in diameter there were 15 deaths from the disease and of 34 cases of infiltrating cancer 32 were dead. Smith and Mintz in a study

Fig 380 —Benign papillary tumor near ureteral orifice, causing hematuria No recurrence following fulguration

Fig 381 —Papillary carcinoma treated by fulguration and radon implants January 27, 1929, recurrence with similar treatment April 25, 1934 The patient has been well since last treatment

of 150 cases at the Massachusetts General Hospital found that grade of malignancy determined by the microscopic characteristics of the tumor bore no relation to its tendency to metastasis. Squamous cell cancers in their series metastasized almost twice as often as papillary cancers. V. C. Hunt found that almost twice as many patients with tumors histologically graded 1 and 2 (Figs 380 and 381) were alive after three years as those with tumors graded 3 and 4 These observations closely parallel each other, since the majority of tumors graded 1 and 2 are papillary, while the infiltrating tumors usually show evidence of a higher grade of malignancy in their cells

Jewett and Strong noted in a study of post mortem specimens that the potential curability of bladder tumors as determined by metastasis and perivesical invasion of lymphatics and blood vessels varied directly with the depth of infiltration of the bladder wall McDonald and Thompson studied sections of 274 tumors removed either by segmental resection or cystectomy The five year survivals were 38 3 per cent in those in which only the submucosa was invaded When invasion extended into the bladder muscle (Fig 382) 29 per cent lived five years or longer, and only 5 2 per cent of those with invasion of the perivesical fat lived five years It was also noted that the survival rate was much less when the blood vessels were involved and that the prognosis was much better in transitional tumors than in squamous cell carcinoma or adenocarcinoma

Fig 382 —Carcinoma of the bladder treated by cystoscopic excision and radon The patient died twelve months later of cholangitis No evidence of cancer was found at necropsy

Diagnosis —The diagnosis of tumor of the bladder is usually made by cystoscopic examination There are no characteristic symptoms Hematuria occurs in about 70 per cent of cases and is commonly the first manifestation of the disease Bleeding in most cases is profuse, occurs in all the urine and may terminate almost abruptly, not to occur again for weeks or months Such bleeding while characteristic of bladder tumors, is not exclusively so It may occur in hypertrophy of the prostate, in tumor or tuberculosis of the kidney, and occasionally even in hydronephrosis Hematuria of a less profuse and more persistent character may be present in infiltrating and ulcerating tumors and when accompanied by tenesmus and frequency of urination may simulate the symptoms of vesical calculus or tuberculous cystitis In the late stages of tumor of the bladder the urine often smells of decomposed blood The patient is

Fig 383.—Papillary carcinoma of the bladder, grade 3, treated by suprapubic excision of the growth and implantation of radium needles in the base Recurrence ten months later (Fig. 384) treated by fulguration and implantation of 4 millicuries of radon Patient was in good health fourteen years following first operation

Fig 384—Recurrence of papillary carcinoma of the bladder (Fig. 383) and two small stones which formed on suture material

Fig 385—Papillary carcinoma grade 2 Tumor excised suprapubically with high frequency current and radium needles inserted in the base Eight months later a small tumor was found near the apex of the bladder This was treated by fulguration through the cystoscope followed by x ray treatment The patient was well fourteen years following treatment

Fig 386—Appearance of bladder six months following suprapubic excision of bladder tumor as shown in Fig 385

emaciated and the tumor can be palpated by bimanual pelvic examination. It is obvious that if tumors are to be recognized sufficiently early to treat them with reasonable chances of cure, cystoscopy should be done whenever there is hematuria or persistent evidence of bladder irritation Cystoscopy to give adequate information must not be excessively painful.

If the patient is apprehensive and sensitive to pain, caudal or a small dose of spinal anesthesia will permit a satisfactory examination with a minimum of risk. In any case adequate local anesthesia should be used. The entire bladder wall should be carefully inspected both with the bladder distended and partly collapsed. Tumors of sufficient size to produce symptoms are easily recognized. The location, size and number of tumors are important in determining adequate treatment. Tumors located on or near the trigone present a much more difficult surgical problem than those situated in the upper portion of the bladder. Quite frequently they involve the ureteral orifices or are so close to them that resection would require reimplantation of the ureter. Fortunately most tumors located in this area belong to grades 1 and 2 and if seen early are amenable to cystoscopic methods of treatment (Figs. 380 and 381). The majority of tumors located in the upper half of the bladder are grade 3 or 4 and the incidence of infiltration of the bladder wall and of metastasis is greater than in those situated on or near the trigone (Fig 382)

Biopsy specimens while valuable in determining the grade of malignancy cannot be depended upon exclusively as a guide to treatment or prognosis. Tumors with a distinct pedicle do not infiltrate the bladder wall as early as do those with a broad base (Fig. 385). Attention has been called to Shivers' report in which no deaths from tumor occurred when the tumor was attached by a small pedicle When the pedicle is broad and the fronds of the tumor seem to arise directly from the bladder surface, the prognosis is less favorable. Further evidence of malignancy is recognized on cystoscopic examination by congestion of the mucous membrane, bulbous edema, or submucosal nodulation about the base of the tumor.

The pedicles of large papillary tumors are often hid by the overhanging villous processes, making it impossible to see the base of the tumor. The villous processes of the more malignant tumors are often matted together, giving the appearance of a solid tumor when seen through the cystoscope (Figs. 383 and 384). In the lower grades of malignancy the tumor is more loosely constructed and when viewed through the cystoscope numerous fingerlike projections extend into the distending fluid (Figs 385 and 386).

The majority of multiple tumors are microscopically in the lower grades of malignancy. The average life expectancy is greater here than in single infiltrating tumors, but recurrence or the appearance of new tumors is to be expected (Fig. 387).

The cystoscopic appearance of infiltrating tumors of the bladder is quite characteristic Arising from the deeper layers of the mucous membrane, they often infiltrate the bladder wall extensively before breaking through the surface. When seen early there is a nodular hyperemic area, frequently covered in part by bullous edema. As the tumor progresses the surface becomes necrotic

and an ulcer appears The carcinomatous ulcer is usually covered by a gray, necrotic exudate, the margins are indurated, and frequently there are areas of bullous edema Infiltrating tumors extend beneath the surface well beyond the apparent confines of the tumor as viewed through the cystoscope This is an important feature to remember when deciding upon the treatment to be employed Bimanual palpation of the bladder is often helpful in determining the extent of infiltration If the tumor can be felt through the rectum or vagina the prognosis is exceedingly grave When the tumor is very large and cannot be properly visualized through the cystoscope a cystogram is helpful in determining the extent of bladder involvement In extensive tumors the bones of the pelvis and spine and the lungs should be examined by x ray before treatment is begun

Fig 38 —Multiple papillary carcinomas of the bladder treated by fulguration and radon The patient died three years later from extensive recurrence and renal infection

The examination should include a thorough study of the kidneys and ureters, particularly if the growth is at all extensive or is situated at or near a ureteral orifice Bladder tumors accompanying tumors of the ureter or kidney pelves are occasionally encountered and more frequently tumors of the bladder cause ureteral obstruction which seriously impairs or destroys the function of one or both kidneys An estimation of the kidney function should be followed by ureteral catheterization and bilateral pyelograms If ureteral catheterization cannot be done an intravenous pyelogram is desirable

Treatment —The three methods generally employed in the treatment of bladder tumors are diathermy, radium and resection There are definite indica

tions for each of these therapeutic measures but no one is suitable for all types of tumors Each method of treatment may be used alone or they may be used in combination according to the individual indications.

Diathermy.—Diathermy or electrocoagulation is obtained by a bipolar d'Arsenval current. A large electrode consisting of a sheet of metal is placed on the body surface, usually beneath the buttocks The small or active electrode is applied to the tumor either through the cystoscope or through the open bladder. The heat is concentrated at and near the small electrode when it is applied to the tumor. Heat travels in a perpendicular and radiating direction from the active electrode and destruction of tissue is said to occur to a depth approximately equal to the diameter of the tip of the electrode. The heat also interferes with cell vitality at a distance somewhat greater than the area of coagulation. According to Corbus, who has done considerable experimental and clinical work with diathermy, the immediate effect is a slow "cooking through" of the underlying tissues and the effect is the same on the underlying tissues as on the mucosa. There is an aseptic death of the affected tissues with gradual replacement by fibrous tissue. Randall and his co-workers employ 1500 to 2000 milliamperes of current through a flat-disk electrode one centimeter in diameter The electrode is applied until definite bulbing of tissue and liberation of gas occur. This would cause coagulation of tissue for a depth of one centimeter. If less penetration is desired a small electrode should be used. Previous to applying the coagulating current the portion of the tumor protruding into the bladder should be excised with the high, frequency cutting current, using a loop electrode in flat infiltrating tumors and a pointed or knife-shaped electrode for amputating the pedicle of a papillary tumor.

When diathermy is applied through the cystoscope the projecting portion of the tumor may be destroyed to the base by repeated applications of diathermy by a flexible electrode. A better method if the tumor is situated in an accessible location is to remove the tumor down to the muscularis of the bladder with a resectoscope and apply the diathermy current to the base of the tumor with the hope of destroying tumor cells that have infiltrated the deeper structures of the bladder wall.

Diathermy alone is limited in its application to noninfiltrating tumors or to those that have invaded the bladder to a moderate degree It is obvious that to destroy with diathermy a tumor that has invaded the entire thickness of the bladder would result in a fistula into either the rectum, vagina or peritoneum and, even if the tumor were destroyed, little if any benefit would be given the patient. Diathermy may be used to advantage in conjunction with radiation in deeply infiltrating tumors that are not suitable for resection.

Radiation.—Radiation by the use of either radium, radioactive gold, or x-ray is one of the most popular methods of treating bladder tumors The majority of urologists employ either x-ray or radium alone or in conjunction with resection or diathermy and it is the universal last resort in the palliative treatment of the hopelessly advanced cases of malignancy.

Radium is employed as emanations encased in minute gold or platinum capsules (called radon seed or implants), or as radium element in needles to be inserted in the growth and removed or as radium element in capsules to be applied to the surface of the tumor. The use of emanations is the most satisfactory method of applying radium. They are readily available and may be left permanently in the tissues. Each implant of the emanation should contain two millicuries of radon which will supply sixty milligram hours of radiation. The radon units are effective within a radius of one half centimeter and therefore should be applied one centimeter from each other throughout the tumor (Figs 388 389 and 390). According to Keyes as many as twenty radons may be implanted without fear of more than temporary irritation. In large tumors as many as forty may be implanted but caution must be taken not to insert them into healthy bladder tissue, so that the bladder wall will be spared the cauterizing effect of the radium. In small tumors radons may be inserted through the cystoscope but when a large number are to be implanted suprapubic exposure is more satisfactory.

When radium needles are used suprapubic exposure is necessary and the needles each of which is attached to a linen or silk thread are removed after a sufficient amount of radiation has been delivered. In the bladder, needles containing from two to five milligrams of radium should be employed. They are not to be advised when emanations are available.

Large amounts of radium two hundred or more milligrams in a capsule may be applied to the surface of the tumor using an especially constructed cystoscopic sheath. The radium capsule is placed in the terminal end of the instrument and applied to the tumor under direct vision. This method of treatment is used at the Brady Urological Clinic, Johns Hopkins Hospital with considerable success. One hundred to two hundred milligram hours of radiation are given at each treatment and about eight hundred milligram hours in a single course of treatment. Very few surgeons are supplied with a sufficient amount of radium in proper containers for this method of application, furthermore, it probably has no advantage over the use of radon emanations.

The excessive use of radium in any form will cause very severe irritation of the bladder, and extensive sloughing and fistulas may follow. Infection of the bladder is intensified by any form of radiation and large amounts of radium implanted in infected bladder tumors may result in severe infection of the urinary tract. Smith and Mintz noted that the mortality from the use of radium was greater than that of bladder resection or the use of diathermy. Barringer warned of the danger of using large amounts of radium through the infected open bladder and in such cases advises smaller repeated doses administered through the cystoscope.

X ray therapy alone is rarely used as a curative treatment of bladder tumors. Colby and Smften treated 130 tumors of the bladder not suitable for surgery with external radiation with the 120° kilovolt unit. Papillary and non papillary tumors responded about equally well and regression occurred in about one third of the cases. Distressing symptoms were relieved in about half the patients and seven patients have survived five years tumor free. In

Fig 388 —Cystoscopic implantation of radon into infiltrating tumor of the bladder

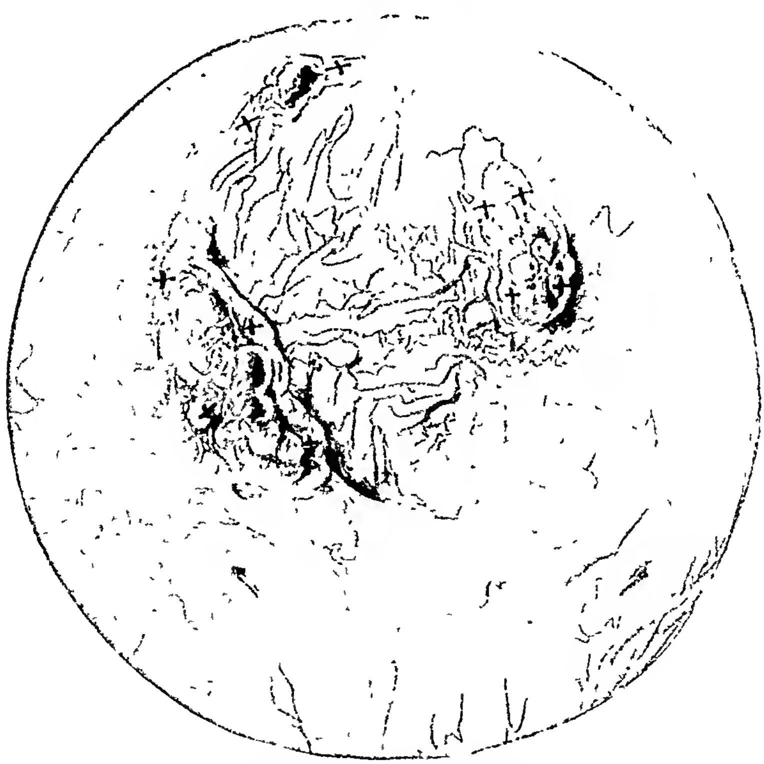

Fig 389 —Appearance of bladder two months following cystoscopic implantation of radon (Fig 388), treatment repeated

the more malignant tumors it is of decided value in combination with radium or diathermy and is a useful palliative measure in the control of bleeding and referred pains from metastasis. Sensitivity to x-ray increases in proportion to the degree of malignancy. Keyes suggests the use of x-ray by the Coutard method in all tumors except true papillomas regardless of the local curative therapy. Excessive amounts of x-ray in an attempt to destroy advanced malignancy of the bladder may cause irreparable damage to the bladder, with intense and prolonged discomfort to the patient. Radiation therapy in the treatment of malignant tumors of the urinary tract will be elaborated in Chapter XXXI.

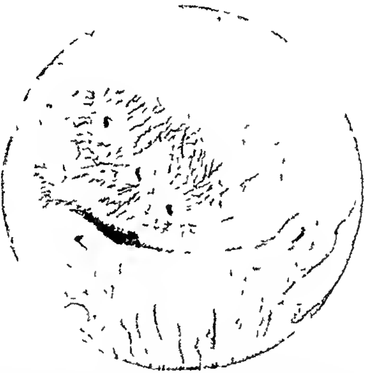

Fig 390.—Appearance of bladder (Figs 388 and 389) four months following last treatment. The patient died six months later of pneumonia. There was no clinical evidence of tumor.

Resection of the Bladder.—Resection of a segment of the bladder wall is applicable to all tumors so situated that the entire tumor can be removed with a margin of normal bladder wall and the wound so sutured that normal bladder function will be resumed (Figs 393 and 394). This method of treatment is not necessary in papillary tumors unless the bladder wall has been deeply infiltrated. Papillary tumors of grades 1 and 2 can be adequately treated by diathermy or the implantation of radium. Resection is best suited to tumors situated in the upper half of the bladder, but may be successfully executed in early infiltrating tumors in any portion of the bladder. Involvement of the ureteral orifice complicates but does not necessarily preclude segmental resection. The ureter may be divided as it enters the bladder and reimplanted as near its normal location as possible when the bladder has been reconstructed.

When the tumor has extended beyond the confines of the bladder, resection is inadequate and better palliative results can be obtained by the use of radium or diathermy fortified by x-ray treatment. An exception to this rule may be made if the tumor is confined to a portion of the bladder covered by peritoneum. Here a segment of the bladder wall including the peritoneal surface can be removed with the hope of cure if metastasis has not occurred.

Cystectomy.—Since the first edition of this book was published, there has been evidence of more interest in cystectomy The use of sulfonamides and antibiotics has greatly lessened the dangers of ureterointestinal anastomosis Consequently, the mortality rate in recent reports compares favorably with that of other extensive surgical procedures In 1947 Higgins stated that there was no operative mortality in his last twenty-two cases, and Ferris and Priestley reported a mortality of only 8 per cent in patients operated upon from 1942 through 1946. Only 19 per cent of their patients operated upon five years or more previously were alive. Most of their earlier patients had long-standing deeply infiltrating lesions. There had been no deaths from recurrence or metastasis in patients with superficially infiltrating tumors

Cystectomy is justified when an early infiltrating cancer is so situated that it cannot be removed by segmental resection or when the bladder has become incapacitated because of repeated efforts to cure multiple recurrences. Cystectomy is rarely justified as a last resort or as a palliative procedure in cases of advanced carcinoma of the bladder

Choice of Treatment.—A study of the literature on bladder tumors shows a rather wide divergence of opinion as to the efficiency of the different methods of treatment. Men of wide experience advise radiation, chiefly by the use of radium, almost to the exclusion of other methods, while others with equal experience question the advisability of its use at all. Some surgeons believe that if a tumor cannot be treated by segmental resection of the bladder, there is little probability of relief, while others are of the opinion that diathermy alone should be used in all cases In a statistical study Orr, Carson and Novac found that of 267 urologists who answered the questionnaire 122 used bladder resection only, when possible; 87 utilized surgical diathermy through the open bladder exclusively; 177 employed radium in some form with or without diathermy, and 75 did not use radium at all. They were almost equally divided in their opinion as to the efficiency of x-ray therapy. Each of these methods of treatment has a very definite place in the therapy of bladder tumors and the best results will be obtained by the surgeons who equip themselves to apply the method best suited to the individual case. With the exception of the relatively benign papillary growths that do not infiltrate the bladder wall, all tumors of the bladder are definitely malignant and, as in all cancers, permanent results by any method of treatment have not reached a gratifying proportion The condition often goes unrecognized and the symptoms of hematuria or bladder dysfunction are neglected by the patient or his physician until the tumor is no longer confined to the bladder or until obstruction of the ureters has irreparably damaged the function of the kidneys. Furthermore most patients with a tumor

of the bladder have reached the age when unrelated systemic disease may prove a disturbing factor in recovery from any major operative procedure. The choice, therefore, depends upon the grade of malignancy, the location and the stage of development of the tumor, the function of the kidneys and the general physical condition of the patient.

Small noninfiltrating papillary tumors, particularly those with a small pedicle or those graded 1 by microscopic examination of biopsy specimens, are satisfactorily treated by electro-coagulation administered through the cystoscope. If the tumor is so situated that it can be easily reached, removal of the tumor down through the mucous membrane with the loop of the resectoscope followed by thorough electro-coagulation of the base is an excellent method of treatment.

Small papillary tumors of higher grades of malignancy should be treated in a similar manner with the addition of radon implanted in the base or the local application of radium by a cystoscopic radium applicator.

Larger papillary tumors, particularly those that have reached such proportions that the confines of the tumor cannot be readily outlined by cystoscopic examination, should be treated by suprapubic section.

Large noninfiltrating tumors may be adequately removed by excising the tumor at its base, preferably with a high-frequency electrode, and applying surgical diathermy to the base. If the tumor has infiltrated the bladder wall radon seed should be implanted in the base or a segment of the bladder should be resected, depending upon the location of the tumor. Radioactive gold and cobalt are being used in the treatment of bladder tumors. Further time is needed to determine their effectiveness. If surgical diathermy includes a ureteral orifice a catheter should be passed and the kidney drained a few days following operation.

Flat infiltrating tumors of the bladder should be treated by segmental resection of the bladder, by cystectomy, or by radiation. If the tumor has not invaded the perivesical tissues and is so situated that it can be removed with a healthy margin of bladder wall without seriously impairing the function of the bladder, resection is the treatment of choice. No method of treatment of any malignant tumor gives as good results as excision, provided the entire growth can be removed.

Cystectomy should be reserved for those cases in which an infiltrating tumor is so situated or involves so much of the bladder wall that segmental resection cannot be done and in which the tumor is believed to remain confined to the bladder, or in rapidly recurring multiple papillary tumors. When used in far advanced cases or as a last resort when persistent recurrence has followed other methods of treatment the operation is doomed to failure by metastasis or insufficient renal function. The bladder should never be removed solely as a palliative measure. Severe bladder pain and frequency can be relieved as effectively by ureterocutaneous anastomosis. Cystectomy necessitates anastomosis of the ureters to the skin or to the large intestine. Ureterocutaneous anastomosis is the safer procedure but entails continuous and permanent attention and in many cases deprives the patient of an active life. Ureterointestinal anastomosis

is a more difficult operation and has a higher operative mortality but the patient may lead a normal and active life without the handicap of urinals and prosthetic appliances The surgeon with the technical skill to do a ureterointestinal anastomosis will prefer this operation except in infeebled patients or those with dilated ureters. With the urine diverted, massive doses of radium may be safely administered to the bladder

Palliative treatment must often be substituted for more radical procedures because of the physical condition of the patient or the advanced stage of the disease. A patient under my care was in fair general health and had good bladder function two years after the cystoscopic implantation of radons and the administration of x-ray therapy for an infiltrating tumor of the right lateral wall of the bladder. A small recurrence near the bladder orifice was treated by cystoscopic electrocoagulation. This patient was recovering from an attack of coronary occlusion when the tumor was discovered. Resection, which would probably have effected a cure, was considered too great a risk

In about 20 per cent of cases the growth is too far advanced to attempt curative treatment with any probability of success In some of these, if the kidney function is good and the bladder free of infection, the tumor may be greatly reduced and its progress delayed by x-ray therapy alone or in combination with cystoscopic electrocoagulation or radium. In the very debilitated with advanced tumors bladder discomfort may be relieved by ureterocutaneous anastomosis, and the referred pains from the pressure of metastasis may be benefited by x-ray therapy.

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CHAPTER XXXI

SURGICAL TREATMENT OF BLADDER TUMORS

Excision of Tumors, Transvesical Application of Diathermy, Radium and Radon, Cystectomy, Partial and Total

The surgical treatment of bladder tumors consists of the application of radium or other radioactive elements and diathermy through the open bladder, excision of tumors and resection of a portion of the bladder wall, and total cystectomy. As previously mentioned each of these procedures has its own definite indications, although some surgeons use one procedure almost to the exclusion of all others. Open operation should not be used when the tumor can be treated adequately by cystoscopic methods or when there is no chance of effecting a cure. Unless there is some definite contraindication spinal anesthesia is preferred, complete relaxation is obtained and it is the safest anesthetic when electrical equipment is employed. The blood pressure can be kept stable during spinal anesthesia by the continuous administration of a 5 per cent solution of dextrose, varying the rate of flow according to the blood pressure. The dextrose is also decidedly helpful in preventing shock in long, tedious operations.

A median suprapubic incision is suitable for all operations upon the bladder for cancer except occasional cases in which the tumor is limited to the area including and immediately adjacent to the bladder orifice. In such cases, if resection is elected the operation may be done through the perineum. The suprapubic incision varies in length according to the thickness of the abdominal wall and the type of operation to be done (Fig. 391). A more extensive incision is necessary for resection or cystectomy than for operative procedures within the bladder. In all cases the incision should be long enough to expose the bladder adequately (Fig. 392). Some surgeons prefer a transverse incision through the skin, superficial fascia and anterior sheath of the muscles, and a transverse division of the recti muscles is occasionally advised for extensive operations. I have never seen the necessity of cutting the recti muscles. With the patient well relaxed, especially when spinal anesthesia is used, there is no difficulty in retracting the muscles sufficiently to expose the entire bladder area. The Cherney incision gives excellent exposure.

If the tumor is to be excised or treated with radium or diathermy, the bladder is exposed as described under suprapubic cystotomy (pages 456-459).

Resection of the bladder or cystectomy requires variations in the exposure depending upon the location and extent of the tumor. In all cases a moderate Trendelenburg position permits the intestines to gravitate toward the upper abdomen and makes exposure less difficult.

EXCISION OF TUMORS

Bladder tumors are rarely excised except as a preliminary measure to the implantation of radium. Those suitable for excision alone can usually be ade-

quately treated by cystoscopic methods. Occasionally multiple noninfiltrating papillary tumors or low-grade solitary tumors situated in an area of the bladder inaccessible to the cystoscopic electrode may be satisfactorily treated by suprapubic incision The tumor should be excised by high-frequency current, with a knife-shaped or pointed electrode. With the electrode an incision is made around the base of the tumor down to the bladder muscle. The tumor is then

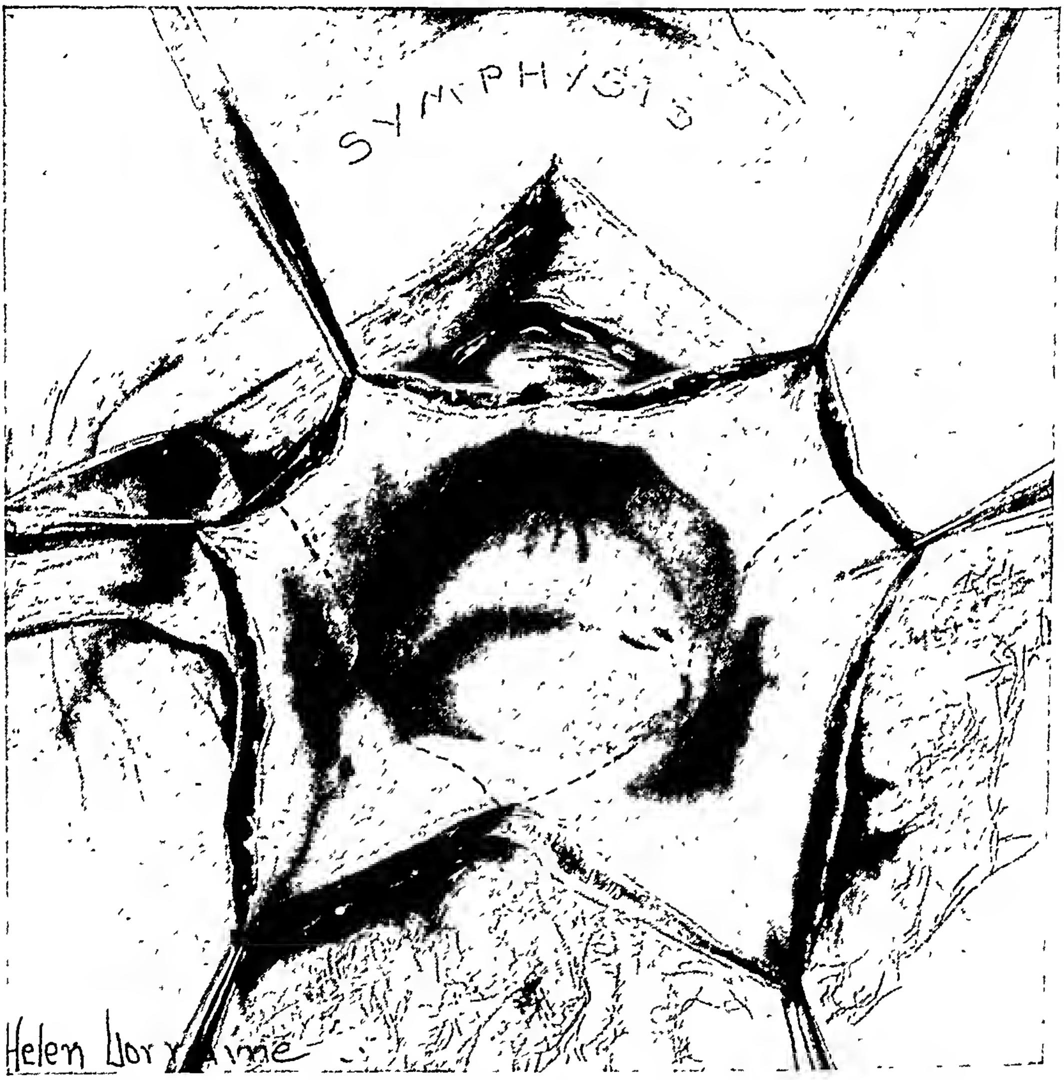

Fig 391.—Operative exposure of the bladder for resection of multiple Hunner's ulcers Dotted line shows line of excision

grasped with a hemostat and the base, including mucosa and submucosa, is dissected free Bleeding is controlled by fulguration of the surface from which the tumor has been removed. The mucous membrane should not be closed over the defect. If there is any question of deep infiltration the area should be resected or, if inaccessible, radium should be applied. When there are multiple tumors a course of x-ray treatment should be given.

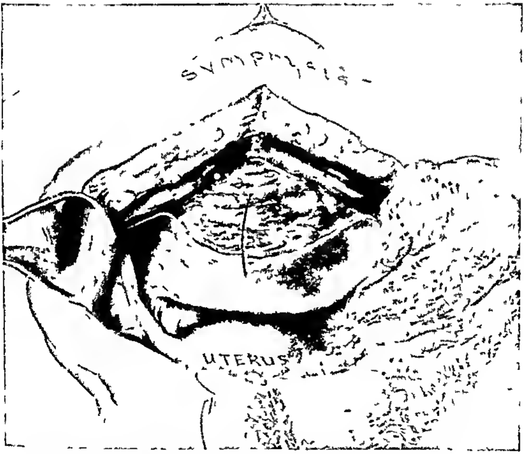

Fig 392—Incision for exposing the bladder for radical resection of cancer involving the posterior wall or base of the bladder

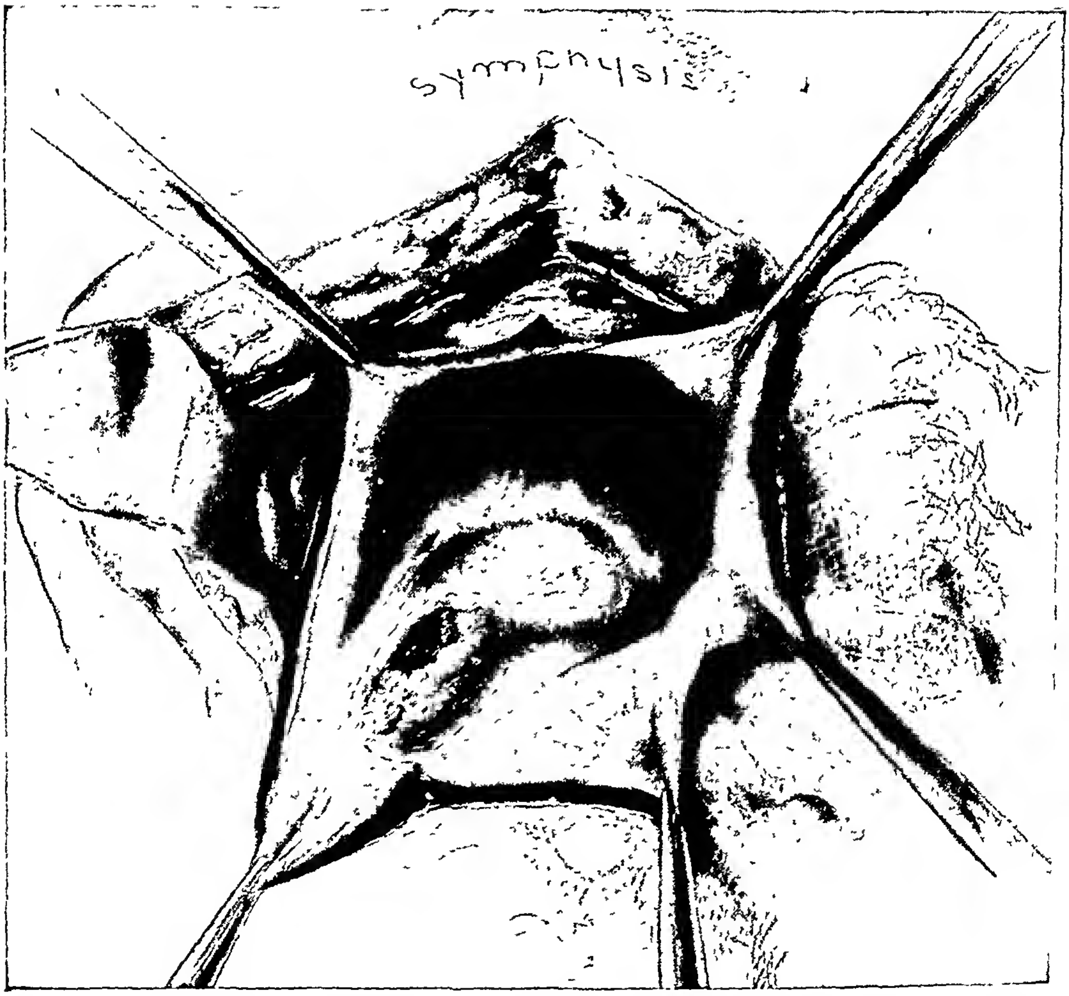

Fig 393 —The intestines are packed off with gauze and the bladder is opened, exposing the tumor Dotted lines indicate the line of excision with the cautery.

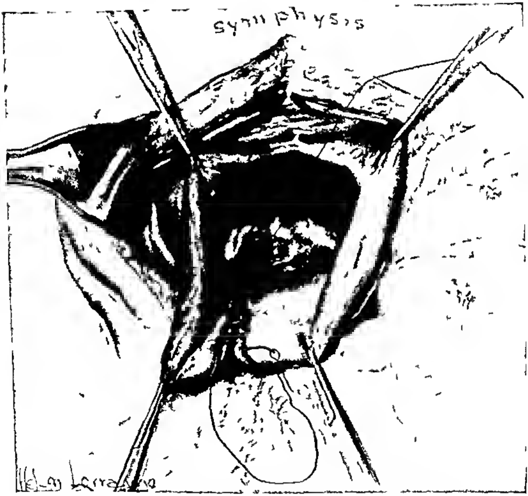

Fig 394 —After resection of the bladder the inner row of sutures is placed catching as little as possible of the mucosa

THE TRANSVESICAL APPLICATION OF DIATHERMY

The following quotation from Randall and Uhle accurately summarizes the variations of current and the clinical uses of the electrosurgical unit.

> "In general, electrosurgery, embodying the principles of the high frequency currents, has a three-fold clinical usage. first, the rapid, bloodless, aseptic severance of the normal tissue; second, the excision or destruction of malignant tissue; and third, the coagulation of blood vessels
>
> "The electrosurgical domain is composed of four general groups. (1) 'Acusection' refers to the cutting of tissue with the high frequency current. This term is derived from 'acusector,' an instrument devised by Kelly and so named by him to differentiate the electrosurgical 'knife' from the scalpel. (2) 'Electrodesiccation' effects destruction by dehydration, the current being of the unipolar Oudin type. (3) 'Electrocoagulation' implies a thermic reaction, death of tissue being produced by heat coagulation of the tissues. This current is of the bipolar d'Arsonval type (4) The term 'diathermy' is synonymous with electrocoagulation The dissimilarity in nomenclature represents a time factor: the longer the application of current, the more extensive the thermal effect in the tissues. Diathermy, therefore, implies a deeper penetration of heat, consequently its destructive effect is greater."

Some form of electrosurgery is used in the treatment of most bladder tumors, either alone or in combination with resection or radium. Lowsley and Kirwin describe the "loop-ball-disk" method of handling large tumors not suitable for resection. The ball is applied to the bladder wall encircling the tumor to seal off the blood vessels The loop electrode with the cutting current is then used to remove the protruding portion of the growth and the disk to coagulate the surface before applying radium When resecting the bladder for tumor, it is my custom to coagulate the entire surface of the tumor and the bladder surface adjacent to the base of the tumor, then to excise the entire area with the high-frequency current with a pointed electrode.

Diathermy alone is curative in some tumors, particularly those that have not infiltrated the bladder wall extensively, and, as has previously been stated, many surgeons prefer it to other types of treatment. In the application of surgical diathermy Corbus advises that on the table be placed several layers of thick paper, then ⅛ inch rubber sheeting which is covered by some heavy woolen material to keep the patient dry, and that the surgeon and his assistant stand on wooden platforms covered by paper and rubber sheeting to prevent short-circuiting For the same purpose head lights or lighted retractors if used should be attached to a battery rather than to a current transformer.

The indifferent electrode, which consists of a piece of blocked tin about 5 × 6 inches, is placed under the patient, just above the buttocks A piece of gauze well moistened with hypertonic salt solution is placed between the electrode and the patient's skin to minimize the danger of superficial burn Corbus considers ether anesthesia extremely dangerous because of the possibility of short-circuiting the current. The active electrode consists of a rubber handle through which a metal core passes The proximal end is attached to the cable of the diathermy machine and the metal applicator is screwed into the distal end. Ap-

plicators of different size and shape may be used, depending upon the particular situation The retractors should be rubber because metal is a conductor of electricity and may be accidentally touched by the active electrode A glass speculum is suggested by Corbus to protect the bladder wall and a Barnes bag in the rectum to elevate the base of the bladder and protect the rectum While these accessories are useful, they are not absolutely essential The electrode is placed firmly against the tissue to be destroyed and the current turned on The bubbling of gas and escape of steam from the margins of the electrode are indications of sufficient length of application If the tumor has not been covered by the electrode, the electrode should be moved to another area and the procedure repeated

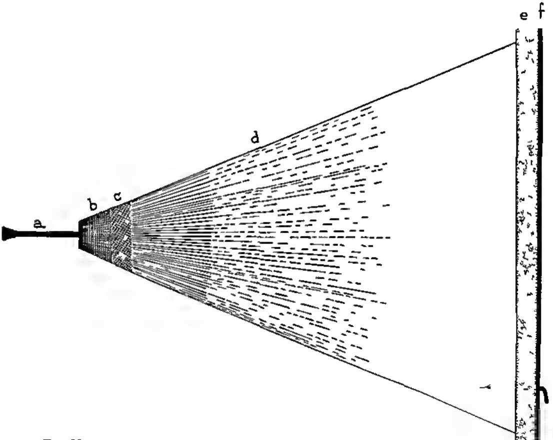

Fig 395—*Diagrammatic representation of what occurs under active electrode in surgical diathermy* *a* one fourth inactive disk electrode *b* tissues visibly coagulated to a depth approximately equal to the diameter of the disk electrode used *c* area of tissues in which the current density has been insufficient to cause coagulation but has probably been sufficient to destroy the vitality of the cells *d* gradual diminution of current density and healing effect *e* thick pad of gauze saturated in warm saline solution (1 ounce salt to 1 pint of water) *f* large indifferent metallic electrode (Reproduced from Saberton Claude Diathermy in Medical and Surgical Practice) (Corbus I C The Treatment of Tumors of the Bladder Without Local Excision By permission of Surgery Gynecology and Obstetrics 33 517 5 8 19 1)

The size of the electrode should vary according to the depth of tissue to be destroyed A flat disk is most satisfactory Coagulation is said to occur to a depth equal to the diameter of the active electrode The current passes in a perpendicular and radiating direction (Fig 395) In the deeper structures coagulation is not produced but the vitality of cancer cells is affected by the heat Blood and lymphatic vessels are sealed so guarding against metastasis

When treating papillary tumors the protruding portion should be excised with the high-frequency current followed by the application of diathermy to the base of the pedicle (Fig. 396).

The effect upon the tissues depends upon the amount of current used and the length of application. An excessive amount of current or too prolonged application will cause extensive sloughing followed by fistulas and the patient may be left permanently crippled although cured of the tumor. Corbus applied one ampere of diathermic current to the bladder wall of a dog over an

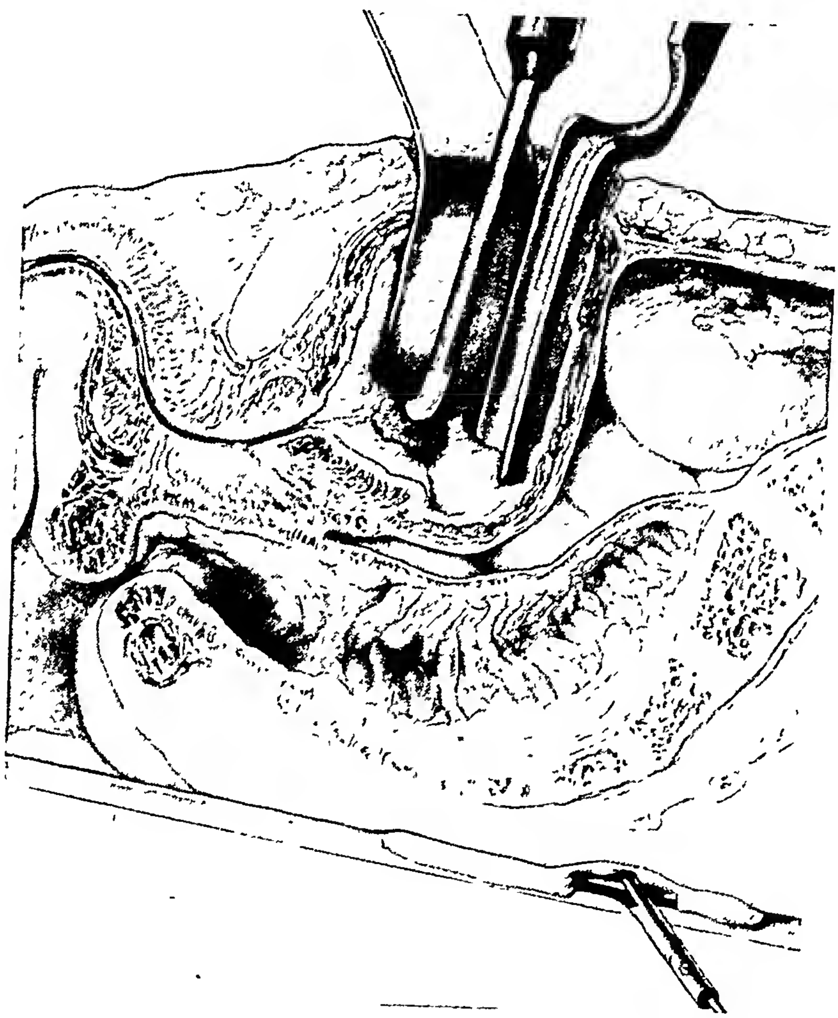

Fig. 396.—The application of surgical diathermy to bladder tumor

area one inch square for 30 seconds. Forty-eight hours later examination of the specimen showed complete destruction of the mucosa, submucosa and superficial layers of muscle. Randall and Uhle employ 1,500 to 2,000 milliamperes of current through a disk electrode one centimeter in diameter. The electrode is applied until ischemia is obtained with bubbling of the tissue and the liberation of gas. They suggest the insertion of a finger in the rectum or vagina to elevate the area and to gauge the amount of heat. It is particularly desirable to combine

radium with diathermy when there is deep infiltration of the bladder wall and when sufficient diathermy to destroy the growth would endanger adjoining structures Radon seed or small needles of radium may be used The radium should be implanted in the depth of the growth, depending upon diathermy to destroy the superficial portion of the tumor Radioactive gold or cobalt is now being used by some surgeons in preference to radium

THE TRANSVESICAL APPLICATION OF RADIUM

Radium emanations must be obtained from a distance in most instances, therefore, it is necessary for surgeons to determine the amount of radium to be used, by preoperative examination This is done by estimating as accurately as possible the volume of the tumor to be irradiated Papillary tumors are excised at the base and radium is inserted in the infiltrating portion of the growth, therefore it is necessary in such cases to estimate the volume of the interstitial portion of the tumor The surface area to be irradiated may be determined by estimating the dimensions of the tumor by a calibrated ureteral catheter inserted into the bladder or more accurately by the use of Kirwin's instrument for measuring bladder tumors Determination of the thickness of the tumor is more difficult Some idea may be obtained by vaginal or rectal palpation In most cases tumors suitable for radium treatment are not more than one centimeter thick or may be reduced to 1 centimeter in depth by electrosurgical excision Therefore only one plane of radiation is usually necessary

The threshold erythema dose of radiation is the unit of quantity by which tissue doses may be expressed The tissue dose applied to any tumor depends upon the number of radon implants used their strength measured in millicuries, and the distance they are placed one from the other There is no way of determining at the present how much radiation is necessary to destroy a given tumor Archie L Dean states that a study of a series of patients with known bladder cancer who were apparently cured, five years after radiation, showed that the minimum tissue dose given was 10 He considers 12 the average tissue dose desirable in the treatment of bladder tumors It is the usual custom to plant gold radon seeds, of approximately 2 mc each, one centimeter apart at the vertices of equilateral triangles throughout the growth and one centimeter beyond its margin When properly placed 1 5 mc radon seed will give adequate irradiation and should be used in large tumors to prevent possible damage to adjacent organs from excessive irradiation The accompanying table which has been published by E H Quimby shows how much radon is needed to treat bladder tumors of different sizes with evenly spaced radon implants

The volume of the tumor is obtained by multiplying its three dimensions but no reduction is made for tumors less than 1 cm thick—for example, a tumor 4 cm wide, 5 cm long and 0 75 cm thick would be treated as a tumor whose volume was 20 cubic centimeters and from the table given, would require 34 8

THRESHOLD ERYTHEMA DOSES	VOLUME OF TUMOR IN CUBIC CENTIMETERS 10	20	30	40	60	80	100
				Millicurie Hours			
10	2,750	3,800	4,700	5,300	6,500	7,500	8,450
12	3,300	4,560	5,640	6,360	7,800	9,000	10,140
15	4,125	5,700	7,050	7,950	9,750	11,250	12,675
				Millicuries Destroyed			
10	21	29	35	40	49	56	64
12	25.2	34 8	42	48	58 8	67	77
15	31.5	43	53	60	73	84	96

(From "Treatment of Cancer and Allied Diseases," Pack and Livingston, Vol III, Chapter CVII.)

millicuries of radon, which would furnish 4,560 millicurie hours of radiation and supply 12 threshold erythema doses of radiation when applied in properly distributed radon seed When estimating the number of radon seed to be used, allowance should be made for irradiating the zone immediately surrounding the tumor. Infiltrating tumors often extend for some distance beneath apparently healthy mucous membrane To a tumor 4 × 5 cm. should be added a 1 cm. area surrounding the tumor, making the entire area 6 × 7 cm., and the volume of the area to be irradiated if not more than 1 cm thick would be 42 cubic centimeters. There is little doubt that much of the dissatisfaction with radium as a therapeutic agent in the treatment of bladder cancer results from inadequate dosage It is therefore important to secure an amount of radium for sufficiently thorough irradiation of the entire tumor area. If sufficient radium is not available some other form of treatment should be given.

Surgical Technique.—After exposing the bladder suprapubically and protecting the abdominal wound with gauze sheets, the fluid used to distend the bladder is permitted to drain out through the catheter and the bladder is opened by a liberal longitudinal incision. The bladder should be separated from the perivesical tissues only enough to permit adequate exposure. Any remaining fluid is removed by suction. The tumor area is well exposed by properly placed retractors. A self-retaining bladder retractor is very helpful. If high-frequency current is to be used, retractors made of nonconducting material are desirable. Radium may be used alone or in combination with electrosurgery Papillary tumors are excised at the base with the high-frequency current, the bleeding is controlled by coagulation, and radon seed or other radioactive materials are inserted in the base If the pedicle is not too thick to be grasped, a very satisfactory method is to clamp the pedicle as near the bladder mucosa as possible with a curved hemostat. The coagulating current is then applied to the hemostat by bringing the electrode in contact with it until bubbles appear along the margins of the blades The cutting current is then used to sever the pedicle proximal to the hemostat. Flat infiltrating tumors may be implanted with radium without preliminary coagulation but it always seemed logical to me to remove any portion that protruded above the mucous membrane of the bladder with the loop electrode and coagulate the surface before inserting radium. The method of Lowsley and Kirwin previously described is excellent. The radon

seeds are then implanted a distance of one centimeter apart throughout the growth and in a one centimeter zone surrounding it. The seed should be placed as nearly as possible 0.5 cm from the posterior limit of the tumor (Fig. 397). A finger in the rectum or vagina is helpful in placing the seed. The finger should merely sense the point of the needle. If the tumor is not more than 1.5 cm thick, all the seed should be deposited in the same plane. If the tumor is more than 1.5 cm thick, a second plane of emanations should be placed one centimeter superficial to the first. They should be placed so that any three seed form the vertices of an equilateral triangle the sides of which are one centimeter long.

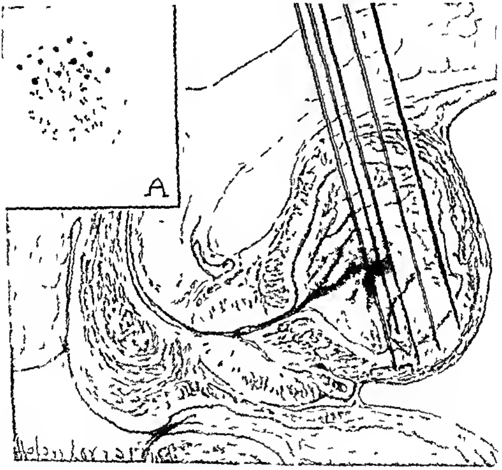

Fig. 39 —The implantation of radon implants into bladder tumor with suprapubic exposure. Insert A, Pattern of inserting radon implants one centimeter apart so that each three units form a triangle. A margin one centimeter wide around the tumor is also irradiated.

When the diathermy treatment is completed, or the radium is inserted, the bladder is flushed out with an antiseptic solution and the wound is closed.

If the diathermy has been of moderate extent, such as treatment of the bases of papillary tumors, the bladder may be completely closed, depending upon a urethral catheter for drainage. In many cases convalescence is decidedly hastened in this way. If the diathermy has been at all extensive, it is preferable

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THRESHOLD ERYTHEMA DOSES	10	20	30	40	60	80	100
				Millicurie Hours			
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12	3,300	4,560	5,640	6,360	7,800	9.000	10,140
15	4,125	5,700	7,050	7,950	9,750	11,250	12,675
				Millicuries Destroyed			
10	21	29	35	40	49	56	64
12	25.2	34.8	42	48	58.8	67	77
15	31 5	43	53	60	73	84	96

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Surgical Technique.—After exposing the bladder suprapubically and protecting the abdominal wound with gauze sheets, the fluid used to distend the bladder is permitted to drain out through the catheter and the bladder is opened by a liberal longitudinal incision. The bladder should be separated from the perivesical tissues only enough to permit adequate exposure. Any remaining fluid is removed by suction The tumor area is well exposed by properly placed retractors. A self-retaining bladder retractor is very helpful. If high-frequency current is to be used, retractors made of nonconducting material are desirable. Radium may be used alone or in combination with electrosurgery. Papillary tumors are excised at the base with the high-frequency current, the bleeding is controlled by coagulation, and radon seed or other radioactive materials are inserted in the base If the pedicle is not too thick to be grasped, a very satisfactory method is to clamp the pedicle as near the bladder mucosa as possible with a curved hemostat. The coagulating current is then applied to the hemostat by bringing the electrode in contact with it until bubbles appear along the margins of the blades. The cutting current is then used to sever the pedicle proximal to the hemostat Flat infiltrating tumors may be implanted with radium without preliminary coagulation but it always seemed logical to me to remove any portion that protruded above the mucous membrane of the bladder with the loop electrode and coagulate the surface before inserting radium. The method of Lowsley and Kirwin previously described is excellent. The radon

to drain the bladder suprapubically with a large tube that will not become occluded by mucus or sloughs In either case the bladder wound should be sutured with two continuous sutures of No 1 chromic catgut the first including the muscles of the bladder wall but avoiding the mucous membrane and the second placed more superficially and burying the first row If a drainage tube is to be used it should be placed at the upper angle of the bladder incision and a purse string suture should be taken in the anterior surface of the bladder surrounding the tube so that when it is tied, the bladder wall will be inverted close to the tube This assures a water tight joint and a dry wound The ends of the suture are left long and are carried through the muscles and aponeurosis of the abdominal wall on each side of the wound and tied across the wound below the tube This fixes the bladder to the anterior abdominal wall for a while and is very helpful if the tube should be pulled out during the first few days following the operation (Figs 398 and 399) A small rubber tissue drain is then placed to the anterior surface of the bladder and brought out near the lower end of the abdominal wound and the wound is closed in layers It is rarely necessary to suture the muscles for suture of the anterior sheath usually approximates them accurately If they are sutured, No 1 plain catgut should be used in a continuous suture drawn just tightly enough to approximate them The anterior sheath or aponeurosis is closed with a continuous lockstitch suture of No 1 chromic catgut If there is much fat on the abdomen this layer may be approximated by a few interrupted sutures of No 1 plain catgut The skin is closed with interrupted sutures of coarse silk or medium silkworm gut

RESECTION OF THE BLADDER

The indications for resection of the bladder in the treatment of bladder tumors are given on page 529 It is important that the location and extent of the growth be determined as accurately as possible Tumors often appear more extensive when the bladder is opened than when viewed through the cystoscope The length of the abdominal incision varies with the thickness of the abdominal wall There must be sufficient room for adequate exposure of the bladder The solution used to distend the bladder is left in place until the upper part of the bladder is liberated The bladder is more easily identified and separated from the adjacent tissue when moderately distended The peritoneum should be opened and the peritoneum covering the bladder examined If it is involved it is resected with the segment of bladder wall to be removed Advantage should be taken of the opening in the peritoneum to palpate the retroperitoneal area and the liver for evidence of metastasis When deemed desirable the iliac glands on one or both sides may be excised

If the tumor involves the peritoneal, covered area of the bladder the intestines are packed off with gauze and retractors are placed in the wound just above the bladder A transverse incision is made in the peritoneum as it is reflected from the bladder posteriorly and any bleeding areas are clamped and ligated (Figs 400 and 401) The fluid is then permitted to drain out of the bladder A longitudinal incision is made in the bladder and carried as far

Fig 398 —The treatment of bladder tumor with radium needles The needles are inserted parallel to the surface of the growth Ureteral catheter inserted to drain the kidney a few days following the operation The other end of the catheter is passed out through the urethra

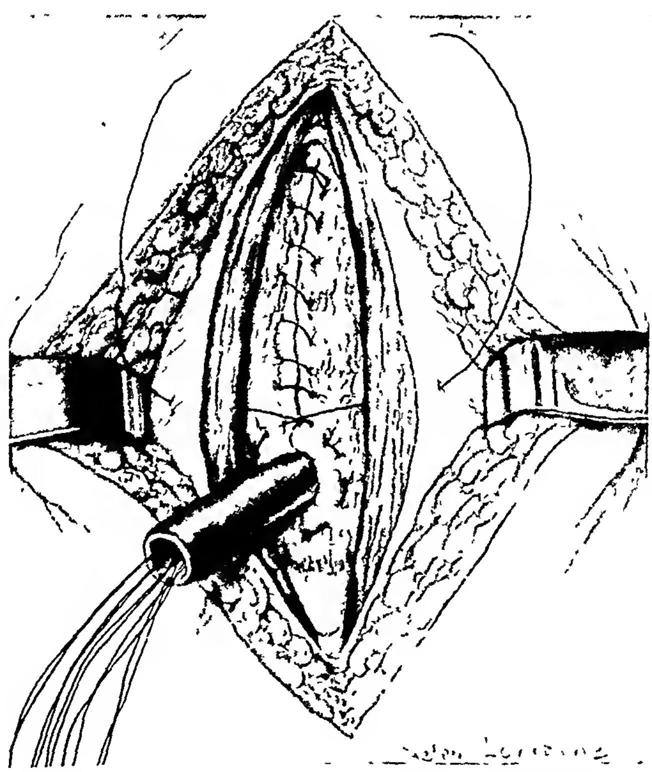

Fig 399 —Closure of bladder following diathermy or implantation of radium When radium needles are used the threads are brought out through the drainage tube and the needles are withdrawn when sufficient irradiation has been given

the catheter by clots, it is better to drain the bladder suprapubically through a stab wound near the apex of the bladder and to one side of the suture line After the bladder has been sutured the gauze packs are removed and the peritoneum is closed with a continuous mattress suture of No 1 chromic catgut, everting the margins of the peritoneum (Fig 404) The abdominal wound is closed, leaving adequate drainage to the bladder

When the tumor is situated on the base or on the lateral wall of the bladder, the peritoneum must be *stripped* from the posterior wall of the bladder to obtain adequate exposure After exposing the prevesical space a transverse incision is made through the fascia and fat down to the bladder just below the reflected

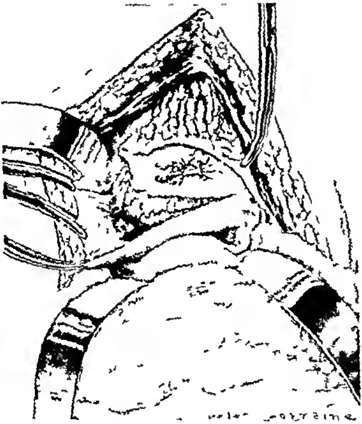

Fig 404 —Peritoneum being stripped from posterior wall of the bladder leaving involved portion attached to the bladder

fold of peritoneum The prevesical fat and fascia are then pushed downward beneath the pubis and the lower flap of the divided vesical layer of the pelvic fascia is sutured to the abdominal muscles at the lower angle of the wound as described under suprapubic cystostomy The peritoneum is then dissected from the anterior wall and the apex of the bladder until the attachment of the urachus is encountered The urachus is doubly clamped and divided (Fig 405) The upper stump is ligated with a No 1 plain catgut ligature and the hemostat is left on the lower stump for traction As an assistant lifts the bladder upward and forward by the attached hemostat, the operator inserts his index fingers be

posteriorly as possible without encroaching upon the tumor (Fig. 402). The bladder wound is retracted and any excess fluid is aspirated. The surface of the tumor is then coagulated with the diathermy current. The tumor-bearing area of the bladder, including the peritoneal covering, should be excised in one mass, with at least an inch of adjacent healthy tissue by elliptical incisions beginning at the upper end of the median bladder incision and passing downward on either side of the tumor to join where the peritoneum has been previously divided. The excision should be done with the high-frequency current,

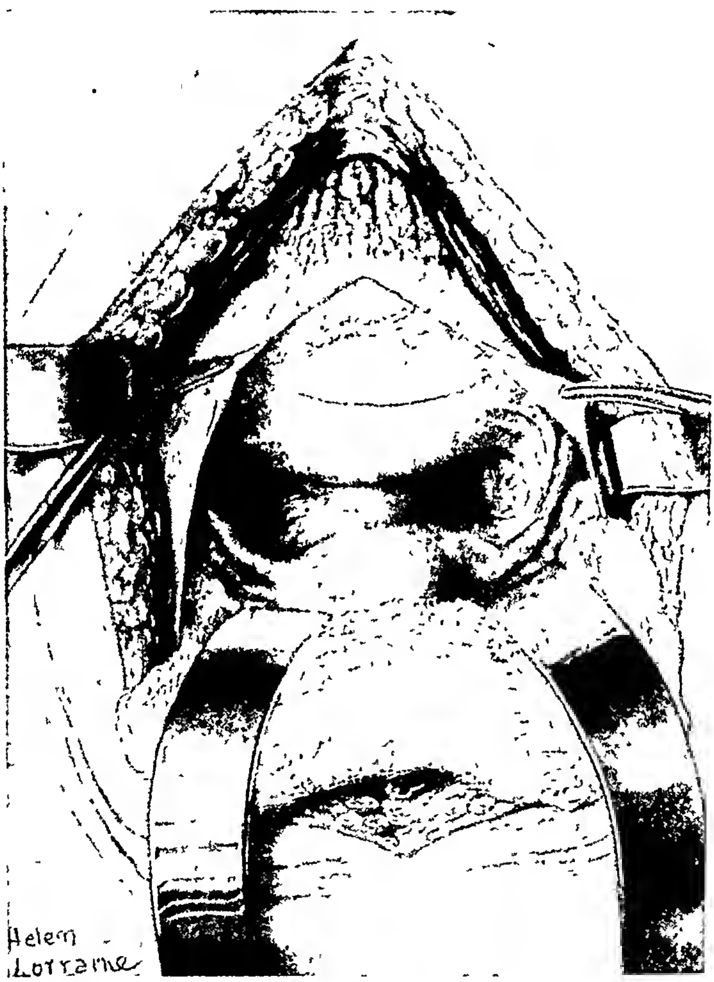

Fig. 400—Suprapubic exposure for excision of infiltrating tumor at the apex of the bladder Curved line indicates area at which parietal peritoneum covering the bladder is divided

using a pointed or knife-shaped electrode (Fig 403). Bleeding points are caught with hemostats and the vessels are coagulated by touching the hemostats with the point of the coagulating electrode when the excision is finished. The wound in the bladder is closed in a straight line with two continuous layers of No. 1 chromic catgut sutures in a small curved needle In the female it is very satisfactory to drain the bladder with a large mushroom catheter placed through the urethra. In the male, because of the danger of epididymitis and occlusion of

the trigone is approached the ureter on the side exposed is recognized entering the bladder In the male the vas deferens passes between the terminal portion of the ureter and the bladder If the ureteral orifice is to be resected, the ureter should be doubly ligated as it enters the bladder and divided between the ligatures The ends of the ligature on the proximal stump are left long for identification The vas deferens can usually be pushed aside, but when necessary it may be divided and the ends ligated

When the bladder has been liberated well beyond the area of the tumor, a self-retaining retractor is placed in the abdominal wound and the exposed surface is covered with gauze sheets The bladder wall is grasped near the tumor as

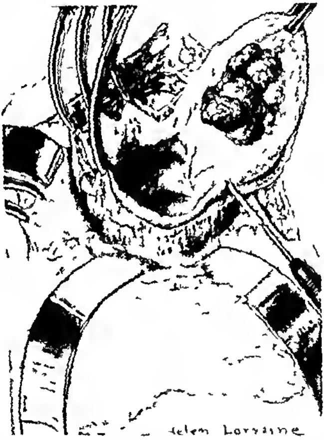

Fig 408 —Excision of the tumor including a broad margin of healthy tissue

previously outlined by cystoscopic examination and an incision is made into the bladder The location of the incision should depend upon the location of the tumor but should not encroach upon it When the bladder is opened, any remaining fluid is aspirated and the incision is enlarged sufficiently to inspect thoroughly the internal surface of the bladder The surface of the tumor should then be coagulated with a blunt electrode After coagulating the tumor surface it is well to outline the incision on the bladder mucosa by lightly coagulating a line surrounding the tumor at a distance of about one inch (Fig 407) With the cutting current and a sharp electrode the tumor area is excised, begin

hind the bladder, one on each side of the adherent peritoneum, and gently separates the bladder from the loosely adherent areolar tissue until the fingers meet just below the area from which the peritoneum is reflected from the bladder. The encircled and adherent area of peritoneum is then dissected from the posterior surface of the bladder with dry gauze (Fig. 406). If the peritoneum is torn the separation is completed and the rent sutured with fine chromic catgut. The fluid is then permitted to drain from the bladder to give more room and the dissection is continued in the direction of the tumor until the bladder is liberated well beyond the borders of the growth on all sides. It is unnecessary to free the bladder further than is needed for adequate exposure of the tumor area. To

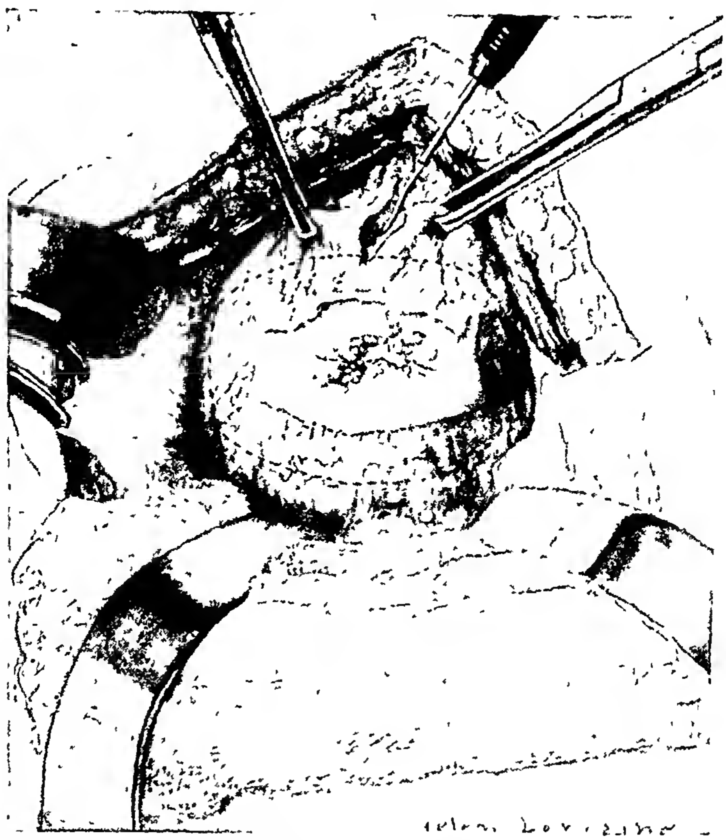

Fig 402—Opening bladder anterior to the tumor Dotted line indicates area to be excised The prevesical space has been closed by interrupted sutures of No 1 plain catgut from prevesical fascia to margins of rectus muscles

liberate the bladder completely and deliver it from the pelvis will probably make the resection and subsequent suturing a little less difficult but will necessitate the severing of a number of blood vessels and nerves that should remain intact and certainly increases the danger of necrosis and delayed healing. If the tumor is confined to the base of the bladder and does not encroach upon either ureter, resection can be done without dividing any large blood vessels Since most tumors involve a lateral wall of the bladder, the arteries and veins of one side must be divided. As they are reached they are doubly clamped, divided and both stumps are ligated before continuing with the dissection As the area of

ing a valve at its entrance into the bladder The end of the ureter is split a short distance and a mattress suture is taken through each flap, carried through the bladder wall, and tied on the posterior surface (Fig 408) The ureter is sutured to the wound of entrance on the posterior surface of the bladder with a few very fine chromic catgut sutures, care being taken not to enter the lumen of the ureter (Fig 409) In most cases after resecting a portion of the bladder the ureter is not long enough to be transplanted in this way and must be carried directly through the bladder wall The method of fixing the ureter is the same, or the end may be left projecting into the bladder In the latter method a few fine plain catgut sutures should be used to fix the outer covering of the ureter to the margins of the wound in the mucous membrane of the bladder

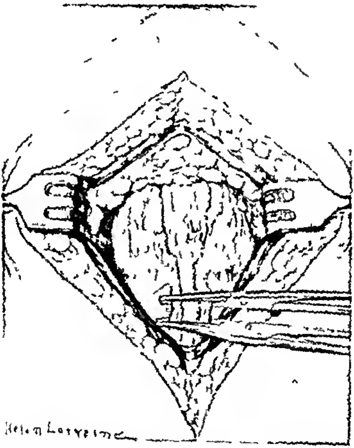

Fig. 40[illegible]—Suprapubic exposure of the bladder for excision of infiltrating tumor at or near the base of the bladder The peritoneum has been stripped back and the *urachus* is isolated and clamped with two *hemostats*

The wound in the bladder is closed by two layers of No 1 chromic catgut sutures as previously described for closing the bladder (Fig 409) These sutures should be placed very accurately to ensure primary healing In the female the bladder may be drained by a large self retaining catheter placed through the urethra In the male it is better to drain suprapubically placing the tube through a stab wound at the apex of the bladder

ning at the end of the bladder incision, encircling the tumor at a distance of about one inch. As the incision is made, bleeding points are clamped and later coagulated, as previously described. When the tumor area has been removed the field is again examined to be sure that no tumor tissue has been left The instruments used are now discarded and others are provided for closing the wound. The sheets used to cover the exposed abdominal surface are replaced by clean sheets. At this point some surgeons advise that the wound be flushed out with 50 per cent alcohol. This, in my opinion, is of doubtful value and is certainly irritating to the tissues If the operation has been done carefully and the surface of the tumor coagulated before excision is begun, there is little probability of transplantation of the cells of the tumor.

Fig 404 —Closure of the wound The peritoneum is closed with a continuous mattress suture of No 1 chromic catgut The bladder is closed in two layers the muscles with a continuous lockstitch suture of No 1 chromic catgut and the fascia with a continuous suture of No. 1 chromic catgut The bladder is drained with a urethral catheter

If the ureter has been divided it should be reimplanted before the bladder incision is closed. An area is selected as near the trigone as the ureter will reach permitting at least 0.5 cm. to project into the bladder without tension. If there is sufficient length of ureter a short incision is made in the posterior surface of the bladder down to the mucosa, the mucosa is dissected up about a centimeter forward, then incised, and the ureter is pulled through, thus form-

ing a valve at its entrance into the bladder The end of the ureter is split a short distance and a mattress suture is taken through each flap, carried through the bladder wall, and tied on the posterior surface (Fig 408) The ureter is sutured to the wound of entrance on the posterior surface of the bladder with a few very fine chromic catgut sutures, care being taken not to enter the lumen of the ureter (Fig 409) In most cases after resecting a portion of the bladder the ureter is not long enough to be transplanted in this way and must be carried directly through the bladder wall The method of fixing the ureter is the same, or the end may be left projecting into the bladder In the latter method a few fine plain catgut sutures should be used to fix the outer covering of the ureter to the margins of the wound in the mucous membrane of the bladder

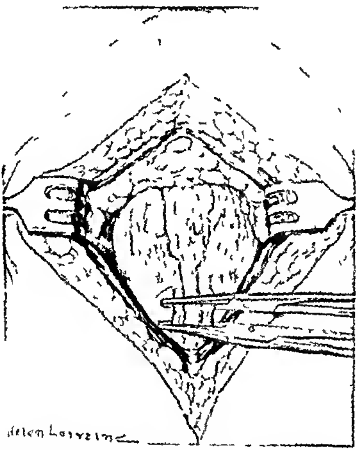

Fig 410—Suprapubic exposure of the bladder for excision of infiltrating tumor at or near the base of the bladder The peritoneum has been stripped back and the urachus is isolated and clamped with two hemostats

The wound in the bladder is closed by two layers of No 1 chromic catgut sutures as previously described for closing the bladder (Fig 409) These sutures should be placed very accurately to insure primary healing In the female the bladder may be drained by a large self retaining catheter placed through the urethra In the male it is better to drain suprapubically, placing the tube through a stab wound at the apex of the bladder

Fig 406.—The urachus is divided between two hemostats (Fig 405) The upper stump is ligated The hemostat is left on the lower stump to be used as a tractor as the peritoneum is stripped from the posterior wall of the bladder

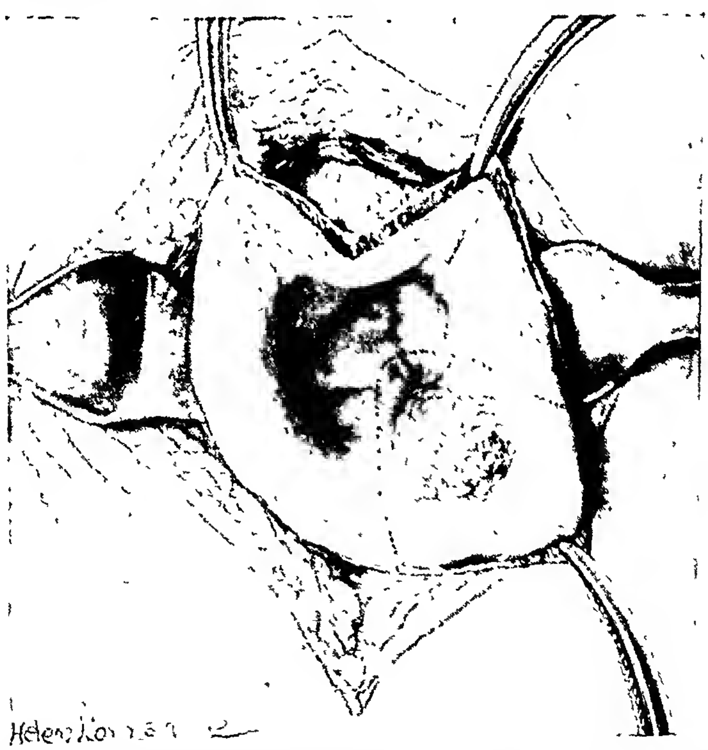

Fig. 407.—The posterior and right lateral wall of the bladder has been dissected free and the right ureter isolated as it enters the bladder Dotted line indicates portion of bladder to be excised This includes the right ureteral orifice because of its proximity to the growth

Fig 408—Transplantation of the ureter following extensive excision of the bladder including a portion of the ureter. The end of the ureter is split about one half inch and drawn through a stab wound in the base of the bladder. The mattress suture in each ureteral flap is sutured to the bladder wall as illustrated by the insert

When the bladder is closed the sheets should be removed and the wound carefully inspected for bleeding areas and sponges. One rubber tissue drain should be placed down to the space of Retzius and one or two, according to the extent of the dissection, down behind the bladder. The abdominal wound is closed accurately around the drains. Better healing is obtained with less chance of stitch abscess by suturing the wound in layers, the muscle with a continuous suture of No. 1 plain catgut, the anterior rectus sheath with a continuous lock stitch suture of No. 1 chromic catgut and the skin with interrupted sutures of coarse silk or cotton. If a suprapubic tube is used to drain the bladder it should be securely fixed to the skin so that it will not be dislodged.

Fig. 409.—Closing the wound following extensive resection of the bladder including the distal end of the ureter The mattress sutures fixing the ureter to the bladder are tied on the posterior wall of the bladder (Fig 408) The anastomosis of the ureter to the bladder is strengthened by interrupted sutures of fine chromic catgut The bladder is closed as illustrated by a continuous lock stitch suture of No 1 chromic catgut This suture is usually buried by a second continuous suture of No 1 chromic catgut catching the fascial covering of the bladder. The bladder may be drained suprapubically or by indwelling catheter

TOTAL CYSTECTOMY

In recent years complete removal of the bladder has been more widely used in the treatment of carcinoma A great many factors have influenced this trend toward the more radical treatment of bladder cancer The small percentage of complete cures by less radical methods, improvements in methods of diverting urine, and a lower mortality from cystectomy are the chief reasons for the more frequent employment of this procedure.

The majority of bladder tumors arise on the base and involve or encroach upon the ureteral orifices or vesical sphincter. Segmental resection, including a safe margin of healthy bladder wall, is at times difficult or impossible in the infiltrating types of tumors, electrical excision, fulguration, and radiotherapy are rarely more than palliative. Improved surgical technique and the use of recently developed chemotherapeutic and antibiotic medication have greatly reduced the mortality and morbidity of ureterointestinal implantation. Many of these patients now live comfortable and useful lives without the crippling effect of nephrostomy or cutaneous ureterostomy. In properly selected patients the mortality from cystectomy should not be prohibitive. The operation is less difficult for the surgeon and no more trying to the patient than a segmental resection involving the base of the bladder and requiring re-implantation of one of the ureters.

Cystectomy is indicated in cases of infiltrating carcinoma so extensive or so situated that there is no probability of a cure by less radical methods, and in multiple tumors of a low grade of malignancy that persistently recur regardless of less radical methods of treatment. It is also indicated when papillary tumors almost cover the surface of the bladder, and when the function of the bladder is greatly impaired as the result of radiation therapy, even though the tumor has been apparently eradicated. It should not be used as a last resort when, in all probability, metastasis has occurred or the tumor has grown beyond the confines of the bladder. The patient's age, physical condition and renal function should give promise of a reasonable life expectancy if the operation proves successful. The operation may be done through a suprapubic incision or by a combined operation in which the bladder is liberated down to the area of the internal sphincter through a suprapubic incision and detached from the deeper subpubic structures from below. In the male it is better to remove the seminal vesicles and prostate with the bladder. A large percentage of tumors requiring cystectomy encroach upon the trigone and in some cases invade the prostate, furthermore, there is the possibility that primary carcinoma may be present or may later occur in the prostate. If the tumor does not invade the trigone or grow within two inches of the internal sphincter, the prostate may be left with reasonable safety, so far as the bladder tumor is concerned. In my own experience, such cases are usually amenable to segmental resection.

Prostatovesiculectomy may be done quite well through a suprapubic incision, particularly in relatively thin patients where the deeper structures do not lie so far beneath the abdominal surface. Those well acquainted with retropubic operations upon the prostate will have little difficulty in freeing the gland from above. Abdominoperineal cystectomy will be preferred by those accustomed to doing perineal prostatic surgery. It is less difficult in corpulent patients and has the advantage of providing dependent drainage.

When cystectomy is decided upon, the urine must be diverted, either by bringing the ureters to the surface of the abdomen or by transplantation of the ureters into the sigmoid or rectum. In most cases it is safer to transplant the ureters at an earlier operation and remove the bladder when the patient has sufficiently recovered. A popular method is to transplant the right ureter and

When the bladder is closed the sheets should be removed and the wound carefully inspected for bleeding areas and sponges. One rubber tissue drain should be placed down to the space of Retzius and one or two, according to the extent of the dissection, down behind the bladder. The abdominal wound is closed accurately around the drains. Better healing is obtained with less chance of stitch abscess by suturing the wound in layers, the muscle with a continuous suture of No. 1 plain catgut, the anterior rectus sheath with a continuous lock stitch suture of No. 1 chromic catgut and the skin with interrupted sutures of coarse silk or cotton. If a suprapubic tube is used to drain the bladder it should be securely fixed to the skin so that it will not be dislodged.

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previously been divided for transplantation, the stumps are liberated and removed with the bladder. If they are to be disposed of after the bladder is removed, they should be liberated throughout their pelvic course, doubly ligated, and divided near the bladder and a ligature left long on the proximal stumps for identification. The bladder is now completely emptied and, as it is pulled upward, the base with the attached seminal vesicles is stripped from the rectum with the finger. This dissection is continued downward, separating the rectum from the posterior surface of the prostate. The bladder is then drawn backward

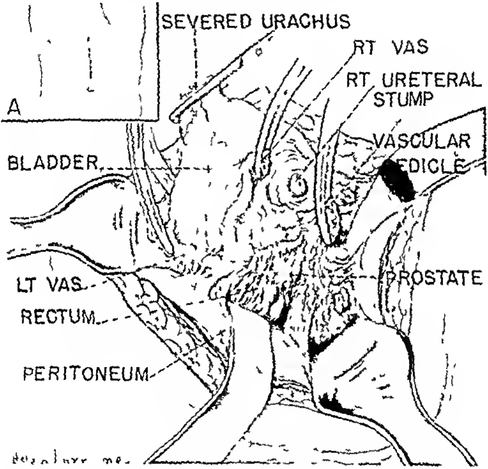

Fig. 410.—Abdominoperineal cystectomy. Shaded area indicates portion liberated from above. Suprapubic dissection may, in the discretion of the surgeon, include liberation of the seminal vesicles and a portion of the prostate.

and bands of tissue connecting the prostate to the symphysis are divided with scissors. The prostate can then be separated from its attachments by blunt dissection, leaving the bladder attached only by the urethra. The urethra is ligated and divided near the apex of the prostate.

If one prefers, the prostate, seminal vesicles and the base of the bladder may be detached in a retrograde manner. The bladder is liberated superiorly and laterally down to the vesical neck, and the ureters, vasa, and superior vesical blood vessels are divided and ligated as previously described (Fig. 410). The

after the patient has sufficiently recovered, to transplant the left ureter and excise the bladder at the same time. This reduces the incidence of postoperative shock and permits the establishment of ureterointestinal drainage from one kidney before the second ureter is transplanted. In vigorous patients bilateral ureterointestinal anastomosis may be done and the bladder removed at the same time. In such cases I have found it an advantage to remove the bladder first and transplant the ureters into the exposed rectum extraperitoneally. The disposition of the ureters will depend largely upon the experience and preference of the surgeon. Transplantation to the skin is much less difficult and is attended by lower mortality. The patient, however, is permanently handicapped by the care of the ureteral orifices and the artificial collecting apparatus Uretero-intestinal anastomosis, while a more difficult and tedious procedure, if successful, restores the patient to a more nearly normal condition. If the kidneys have been impaired by infection or if the ureters are dilated, ureteroenterostomy is contraindicated

Suprapubic Cystectomy.—The bladder, having been irrigated and partly distended with an antiseptic solution, is exposed by a median suprapubic incision from the pubis to the umbilicus. The peritoneum is opened and the retroperitoneal area and the liver are palpated for evidence of metastasis. The iliac glands may be removed if considered desirable. The peritoneum attached to the bladder should be examined for evidence of involvement If one or both ureters are to be transplanted at the time the cystectomy is done, the procedure may be carried out before removing the bladder. The peritoneum is then closed unless the surface attached to the bladder is involved in the growth If it is, the abdominal contents are temporarily protected by gauze sheets. The loose cellular tissue between the dome of the bladder and the anterior abdominal wall is easily separated by blunt dissection The peritoneum is stripped up from the bladder until the attachment of the urachus is reached. The urachus with its accompanying vessels is doubly clamped and divided. The upper stump is ligated and the clamp is left on the bladder attachment for traction. As the fundus of the bladder is lifted upward, the peritoneum is carefully stripped from the bladder If the tumor involves the peritoneal surface, the peritoneum should be incised around the diseased area and the peritoneal cavity closed When the bladder has been freed from its peritoneal attachment, it is pulled upward and by traction first to one side and then to the other, and, as an assistant retracts the abdominal wound, the lateral surfaces are freed by scissors and blunt dissection In dissecting the lateral areas several dense bands of tissue containing the vesical arteries will be encountered. These should be ligated and divided *The lateral vesical pedicles are attached to the bladder* near the ureter. They contain the superior vesical artery (Fig. 410). Below this area blood vessels are found posteriorly beneath the bladder and lateral to the rectum on each side

As the base of the bladder is approached the two vasa are exposed as they cross the ureters (Fig 410). They should be doubly ligated and divided. The ureters are then identified and liberated as they enter the bladder If they have

the bladder from the peritoneum posteriorly and dividing the pubovesical ligaments anteriorly, the dissection is carried laterally, first on one side and then the other The vesical blood vessels and the vasa are divided and ligated and the ureteral stumps are liberated or divided The base of the bladder is separated from the rectum and, if possible, the seminal vesicles and a part of the prostate are also freed from the rectum The suprapubic wound is then closed in layers without drainage

The patient is then placed in the extreme lithotomy position as in the perineal operation for prostatectomy After exposing the prostate as described in perineal prostatectomy (pages 811 814), the urethra is divided at the apex of the prostate A prostatic tractor is inserted and the posterior layer of Denonvilliers' fascia is divided at the apex of the prostate Through this cleavage plane the prostate and seminal vesicles are separated from the rectum up to the point of separation from above (Fig 411) Then the lateral and anterior surfaces of the prostate are separated By keeping close to the prostate, injury of the venous plexus is avoided The liberation having been completed, the prostate, seminal vesicles, and bladder are removed together Adequate drainage is provided and the perineal wound is closed around the drains

Cystectomy in the Female—Cystectomy in the female is a much less difficult operative procedure The liberation of the prostate and seminal vesicles is the most difficult part of the operation in the male The female bladder may be removed by either of the operations previously described Freiberg devised an excellent operation for cystectomy in the female Freiberg liberated the base of the bladder and the urethra through a vaginal incision beginning at the cervix and extending forward and around the urethral orifice After the base of the bladder has been separated from the uterus and the urethra has been freed up to the pubovesical ligaments a suprapubic incision is made and the bladder is freed anteriorly down to the pubovesical ligaments, which are broken through, making continuous the dissection from above and below After carrying the dissection back laterally until the lateral ligaments containing the blood vessels are reached, the urethra is grasped and pulled upward The lateral vesical ligaments are isolated, doubly clamped and divided The peritoneum is then separated from the bladder, the urachus is divided and the bladder is removed Drainage is instituted through the vaginal wound

Marshall and Schmittman described the following method of vaginal cystectomy With the patient in moderately exaggerated lithotomy position, the cervix is pulled down to expose the anterior vaginal wall A transverse incision about an inch in length is made through the vaginal wall approximately half an inch anterior to the cervix The cervix is separated from the bladder by finger dissection, after which parallel incisions are made, extending from each end of the transverse incision outward to the labia minora Actively bleeding vessels are ligated and the vagina is lightly packed to control oozing An incision is then made to encircle the urethral meatus at a radius of at least 3 cm and including the upper half of each labia minora and a portion of the labia majora Inclusion of the clitoris depends upon the extent of the disease This incision is carried down to the periosteum of the pubis and the ends are joined to the

puboprostatic ligaments are then divided, and the dissection is carried anteriorly to the apex of the prostate. The apex of the prostate and the membranous urethra are carefully dissected free with the finger. A catheter in the urethra is an aid in this dissection. The urethra is doubly clamped and divided between the clamps, including the catheter if present. The distal portion of the urethra is ligated and the clamp is removed. The clamp on the proximal end of the catheter is left on for traction. Traction upward is then made on this clamp and the line of cleavage between the fascia of Denonvilliers and the prostate is located, and the prostate is stripped from the rectum up to the seminal vesicles. The fascial layer covering the seminal vesicles is incised, the vesicles are freed, and the entire specimen is delivered Bleeding in the region of the prostate, which may be quite profuse because of injury to the venous plexus, is easily

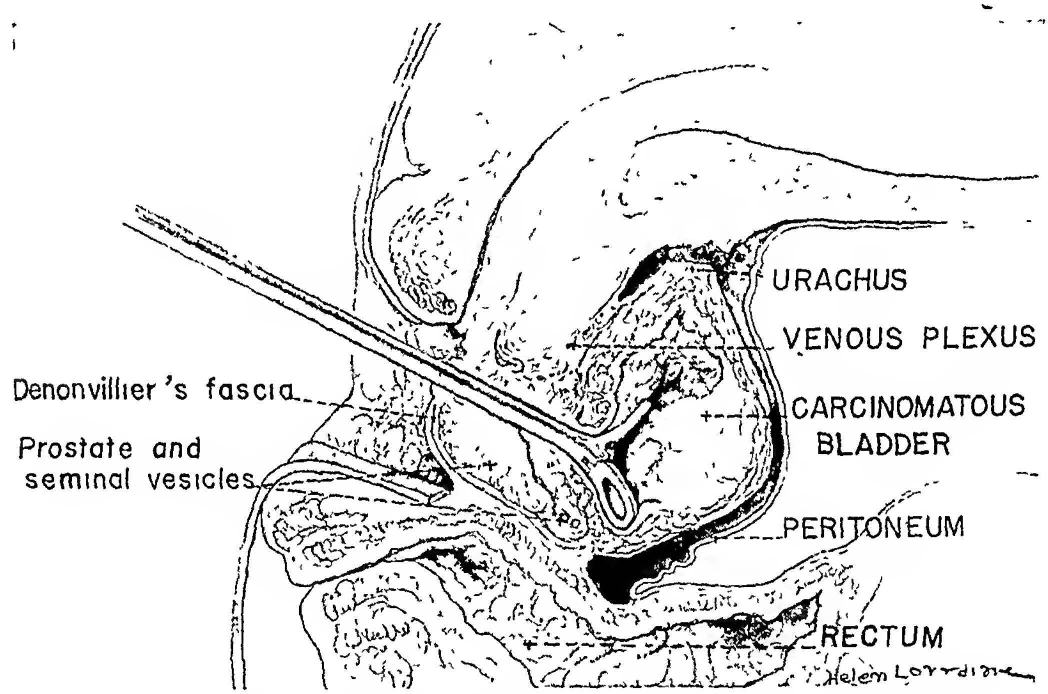

Fig 411—Total cystectomy Illustrating important structures encountered From this point the operation may be completed from above or through the perineum

controlled by packing snugly for a few minutes and then suturing the bleeding areas with plain catgut. The entire cavity is then examined and all bleeding points that can be found are clamped and ligated. If the ureters are to be transplanted to the skin at the same time, the wound is lightly packed with gauze while this is done by the method described on pages 426-430. Before closing the wound two large cigarette drains should be placed in the most dependent portion of the cavity and brought out near the lower angle of the wound The wound is closed as previously described (page 545).

Combined Abdominoperineal Cystectomy.—A combined abdominoperineal cystectomy has the advantage of providing dependent drainage and is the most satisfactory method when the deeper structures are difficult to expose from above. The suprapubic part of the operation is carried out as described above, except that the prostate is not liberated anteriorly or laterally. After separating

the bladder from the peritoneum posteriorly and dividing the pubovesical ligaments anteriorly, the dissection is carried laterally, first on one side and then the other The vesical blood vessels and the vasa are divided and ligated and the ureteral stumps are liberated or divided The base of the bladder is separated from the rectum and if possible, the seminal vesicles and a part of the prostate are also freed from the rectum The suprapubic wound is then closed in layers without drainage

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lateral vaginal incisions. Bleeding at this stage is rather profuse, but the vessels are easily recognized, clamped and ligated. I have utilized this procedure, but did not consider it necessary to place the incision quite so far from the urethral meatus. (Fig. 412.) The tissue which has been surrounded by the external incision is next separated from the periosteum until the pubic arch is visualized. The triangular ligament is divided parallel with and adjacent to the pubic arch. This permits the fingers to be inserted into the loose tissues of the space of Retzius which is widely opened by blunt dissection By staying close to the

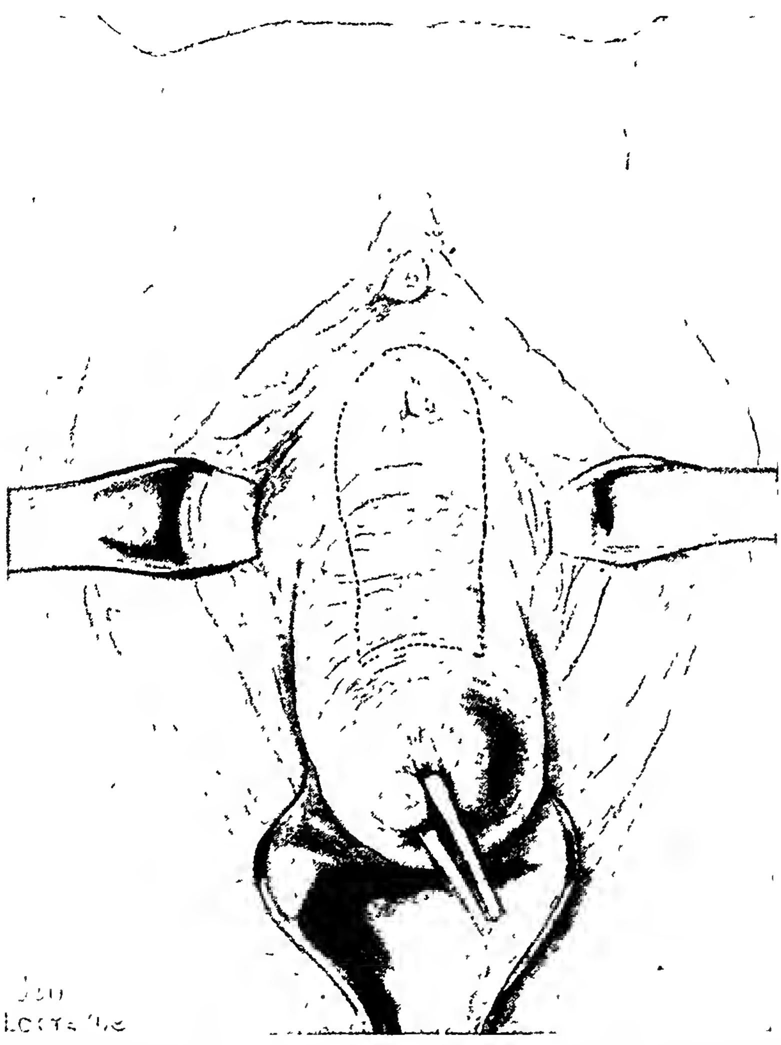


Fig 412—Vaginal cystectomy (Marshall and Schnittman) Outline of incision The originators of this procedure recommend a more extensive incision anteriorly, including a portion of the labia

periosteum, the venous plexus between the urethra and bladder neck is largely avoided and removed with the specimen (Fig. 413) Clamps are placed on the urethra or bladder neck or a tractor is inserted through the urethra (Fig. 413), and by making traction to first one side and then the other, the lateral supports of the bladder are made tense and clamped, divided and ligated until the ureters are cut across (Fig. 414) In order to avoid unnecessary lateral dissection and to prevent the possible clamping of the bowel in the cul-de-sac or clamping the

uterine arteries, the peritoneum should now be identified and opened. This is usually most easily accomplished by pulling down on the dome and dissecting slightly to one side of the midline to avoid the possibly adherent area of the urachus. The authors state that in some cases, by peeling the peritoneum from the posterior bladder wall and cutting the urachal remnants under vision when necessary, the blunt dissection was so easy that no further clamping was required, in which case it was not necessary to open the peritoneum. "However,

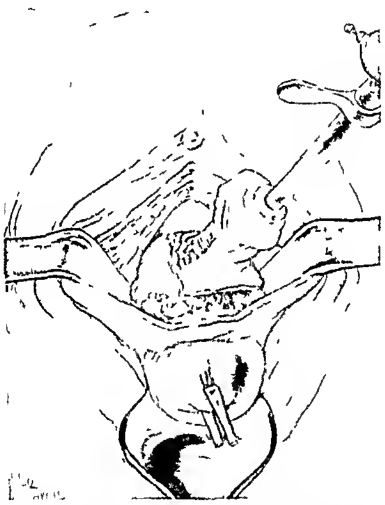


Fig. 413.—Vaginal cystectomy (Marshall and Schulttman). The bladder has been liberated from the cervix and the entire urethra has been liberated, exposing the pubis anteriorly. A Kelly clamp on the urethra may be substituted for the prostatic tractor shown in this illustration.

if the slightest difficulty was encountered or the operator was not completely oriented, a well exposed area of peritoneum was carefully opened." Then with the finger in the peritoneum, the dissection is continued, clamping and ligating any tissues that are necessary until the specimen is entirely free. A patch of peritoneum is frequently removed with the specimen. The peritoneum should be closed with a continuous suture. Chromic catgut sutures are placed in the neck of the cervix and into the periosteum and ligaments of the pubic arch

(Fig. 415). When they are tied, the uterus is brought down to plug the space previously occupied by the bladder. Rubber tissue drains are placed into the retropubic space and brought out on each side of the cervix. The vaginal wall incisions are closed with interrupted sutures of chromic catgut, and the skin is closed with interrupted sutures of silk. If this operation is done at the same time that one or both ureters are transplanted, it is greatly simplified by freeing the bladder from the peritoneum before closing the abdomen.

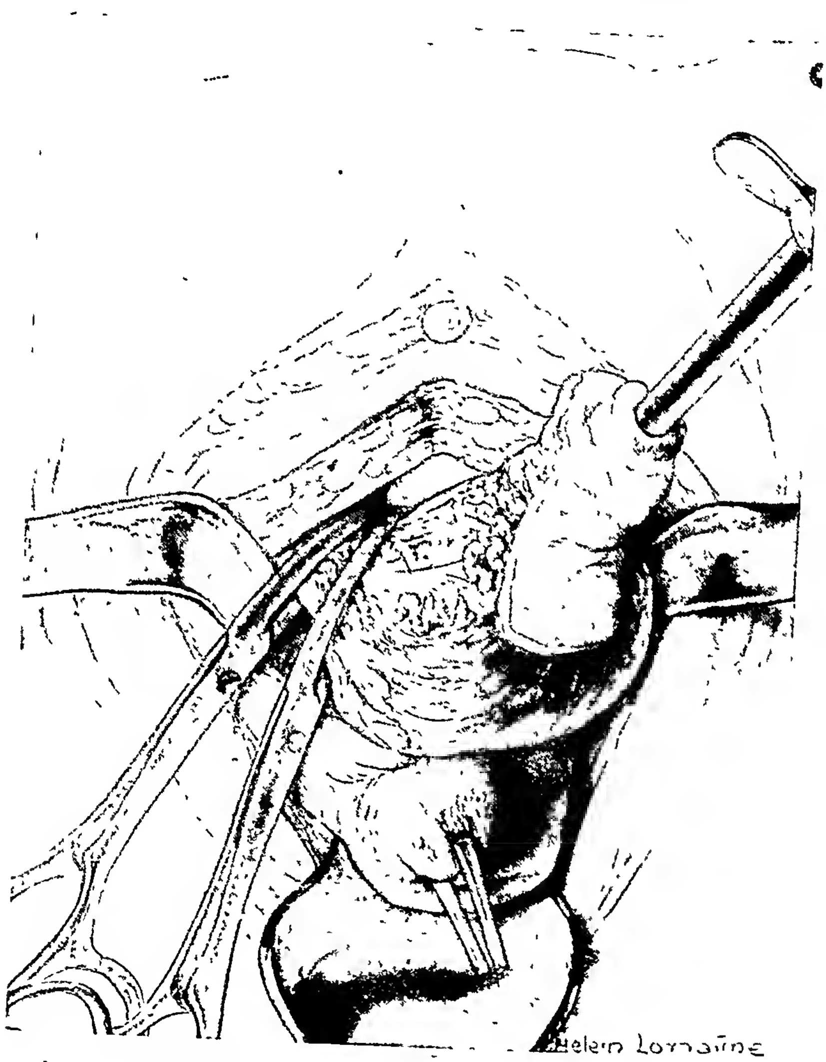


Fig 414 —Vaginal cystectomy (Marshall and Schnittman) The lateral pedicles containing the major blood supply are clamped

Herbert D. Wolff described an operation in which he removed the urethra and lower segment of the bladder and transplanted the ureters to the rectum through a vaginal incision A midline episiotomy was done and an elliptical incision made which surrounded the urethral meatus and included the vaginal vault beneath the tumor, similar to the incision outlined in Fig. 412. The urethra, lower segment and dome of the bladder were liberated (Fig. 413). The anterior bladder wall was then incised transversely, exposing the tumor situated at the apex of the trigone and the ureteral orifices. A transverse incision was

made across the base of the trigone and made to encircle the left ureteral orifice (Fig 416) The tumor encroached upon the right ureteral orifice too closely to permit leaving a cuff of mucous membrane The ureters were catheterized and all the liberated bladder was excised The posterior wall was left in place

The episiotomy incision was then extended upward, exposing the rectum, and the lateral vaginal walls near the cervix were tunneled under by blunt dissection (Fig 417) The ureteral catheters, which had been tied in the ureters,

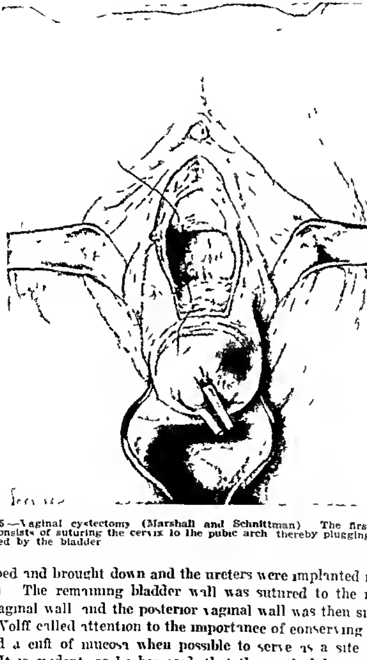


Fig 415.—Vaginal cystectomy (Marshall and Schnittman) The first step in closing the wound consists of suturing the cervix to the pubic arch thereby plugging the space previously occupied by the bladder

were grasped and brought down and the ureters were implanted into the rectum (Fig 418) The remaining bladder wall was sutured to the margins of the anterior vaginal wall and the posterior vaginal wall was then sutured over the rectum Wolff called attention to the importance of conserving the intramural ureter and a cuff of mucosa when possible to serve as a site for transfixing sutures It is evident, as he has said, that the method he used is unwise in principle in carcinoma of the bladder His operation will find a greater field

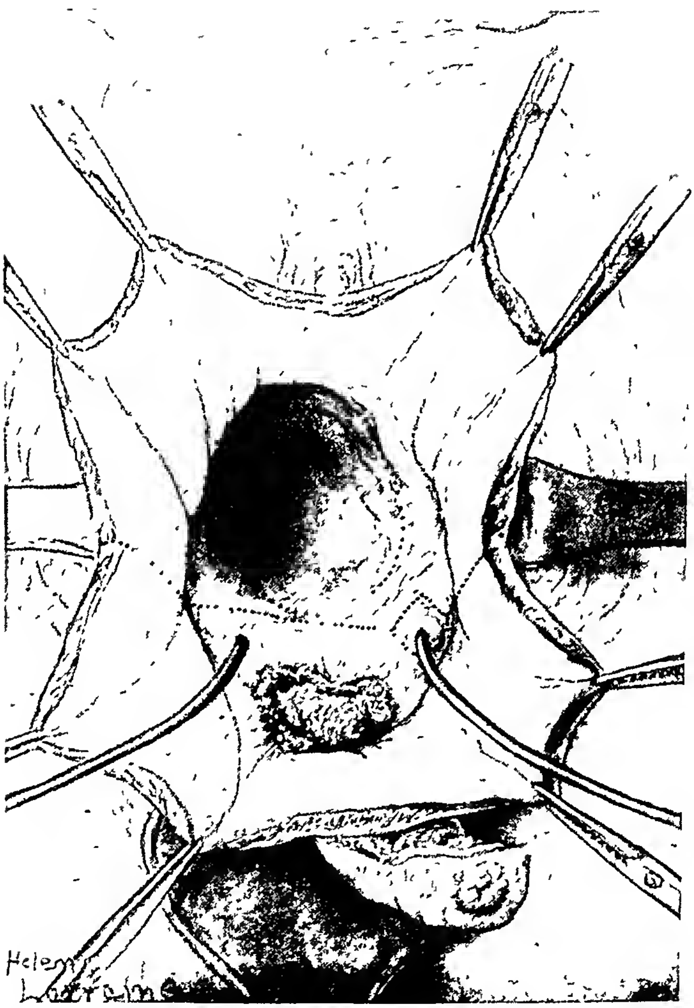


Fig 416—Transvaginal cystectomy and ureterorectal anastomosis as described by Wolff First steps of operation were similar to those illustrated in Figs 412 and 413. The bladder was then opened anteriorly, the ureters were catheterized and liberated from within the bladder. Excision of the bladder was completed, leaving behind that portion attached to the peritoneum

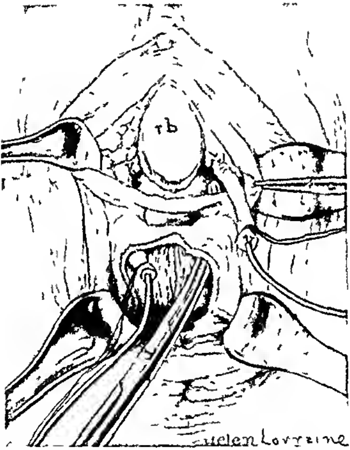
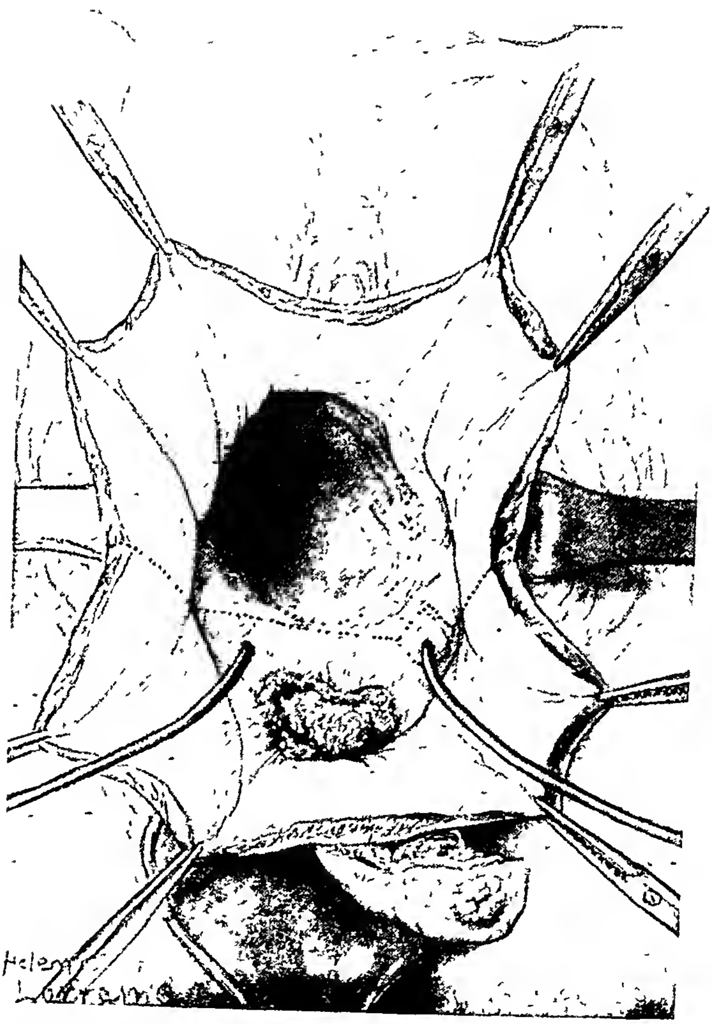


Fig. 41 —Anterolateral vaginal wall tunneled under and ureters brought down to rectum which has been exposed by an incision in the posterior vaginal wall



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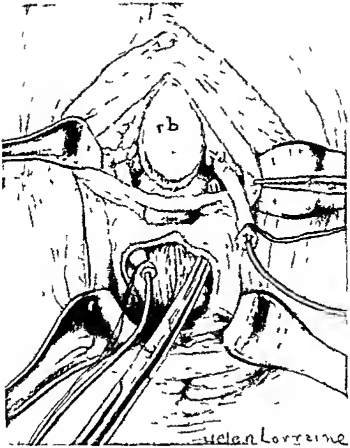
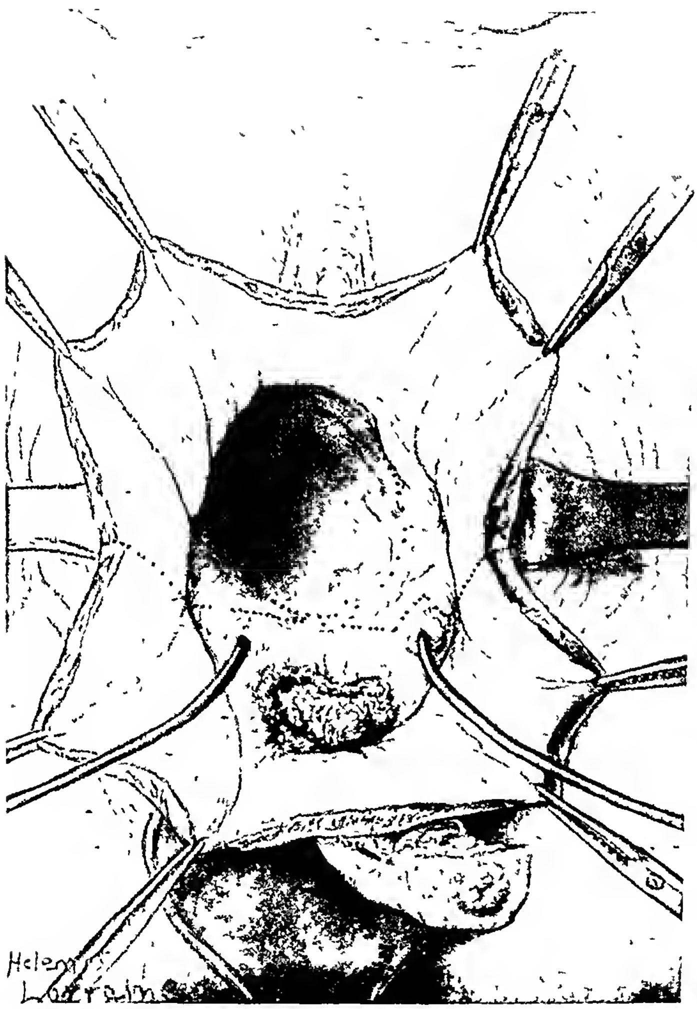


Fig 417.—Posterolateral vaginal wall tunneled under and ureters brought down to rectum which has been exposed by an incision in the posterior vaginal wall



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of usefulness in nonmalignant conditions requiring diversion of the urine to the rectum, and probably in some early cases of carcinoma of the urethra. Wolff also suggests that the residual bladder wall should be sutured to the uterus and pubic fascia, as herniation developed in both his patient and one previously reported by Hunner.

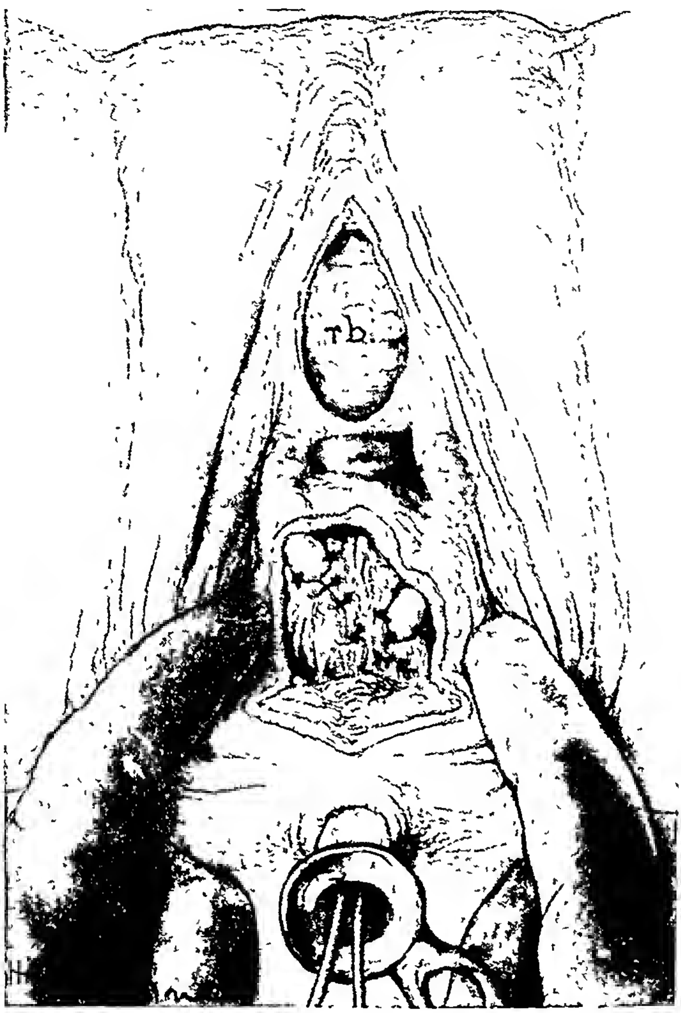

Fig 418.—Ureterorectal anastomosis completed Ureteral catheters protrude through proctoscope

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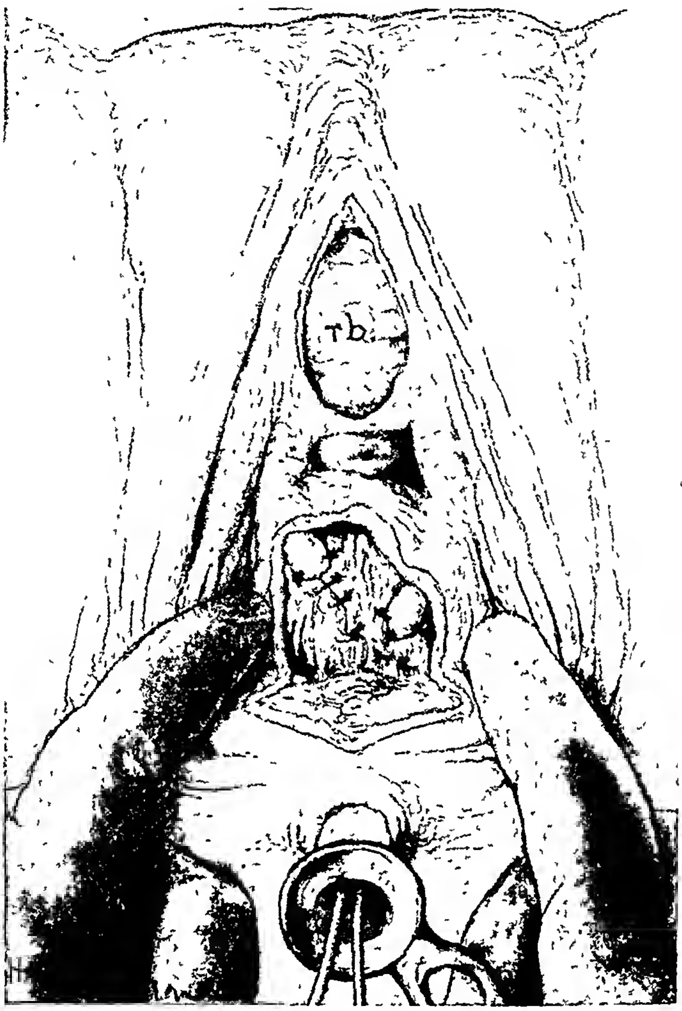

Fig. 418.—Ureterorectal anastomosis completed. Ureteral catheters protrude through proctoscope.

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CONGENITAL ANOMALIES OF THE MALE URETHRA

Congenital obstruction of the urethra consists of (1) stenosis of the meatus, (2) stricture of the urethra, (3) congenital valves of the posterior urethra, (4) hypertrophy of the verumontanum and (5) sclerosis and contracture of the internal sphincter

CONGENITAL VALVES

The most frequent congenital obstructive lesion of the posterior urethra consists of valvelike folds of mucous membrane attached to the walls of the urethra and partly occluding the lumen (Figs 396 and 397) Clinical manifestations of this obstructive lesion are usually recognized during childhood, although occasionally when there is only moderate obstruction the patient may reach adult life before seeking relief There is usually chronic distention of the bladder with accompanying dilatation of the ureters and kidney pelves Renal destruction varies with the degree of obstruction and the age of the child The child is usually underdeveloped and poorly nourished In advanced cases the lower abdomen contains a mass which is the distended bladder The child has a small stream, voids frequently, and with difficulty There is often a history of enuresis or incontinence of urine In advanced cases there is evidence of chronic uremia

Preoperative treatment consists of the establishment of drainage and measures to stimulate renal function and combat infection If the bladder is chronically distended it should be emptied gradually A very satisfactory method is the introduction of a small ureteral catheter This is replaced after a few days with a larger catheter and the bladder is irrigated with an antiseptic solution When maximum function of the kidneys is obtained a cystogram should be done which will outline the bladder and the dilated urethra posterior to the valves Frequently the contrast substance regurgitates into the ureters and the renal pelves If there is no evidence of dilatation of the posterior urethra the obstructive lesion is apt to be a stenosis of the internal sphincter A cystoscopic examination will complete the diagnosis

The valves may be destroyed by a suprapubic or transurethral operation H H Young reported the first case in which a congenital valve was cured by operation The bladder was opened suprapubically, the valve which extended from the floor to the roof of the prostatic urethra was seized by a clamp, pulled into the bladder and destroyed with an electrocautery In later cases Young has used a punch instrument of small caliber to remove these valves transurethrally Meredith Campbell has developed a small resectoscope which gives added advantage of improved vision and coagulation of the cut surfaces In most cases the valves can be successfully destroyed by a small fulgurating electrode operated through a child s cystoscope Following excision or destruction of the valves, the bladder should be drained several days with a urethral catheter

CHAPTER XXXII

THE SURGICAL TREATMENT OF THE MALE URETHRA

GENERAL CONSIDERATIONS

Surgical treatment of the male urethra consists principally of operations for the correction of congenital and acquired defects, for the incision or excision of strictures, and for the excision of malignant growths. Most operations upon the urethra are accompanied or preceded by urethrostomy for temporary or permanent diversion of the urine. Urethrotomy is employed for the exposure of the urethral lumen in the treatment of strictures and for the removal of foreign bodies from the urethra. Incision into the urethra is usually made in the perineal (bulbous), or posterior portion where supporting, soft tissues ensure firm healing. There is very little supporting tissue in the pendulous portion and an incision or injury of the urethral lumen in this area is apt to cause a troublesome fistula.

Preoperative Preparation.—If the operation is one of election the urine should be rendered as nearly sterile as possible by the administration of urinary antiseptics and bladder irrigation when practical a few days before the operation. Colston has shown that there is less febrile reaction and of a shorter duration following operations upon patients who have been given sulfathiazole preliminary to operation than in those without such treatment. It has long been the custom of most urologists to administer methenamine or some other urinary antiseptic several days before the operations in this area. Penicillin and streptomycin are now more generally used to combat infection associated with surgical procedures on the urinary tract. In properly selected cases they are decidedly helpful.

For meatotomy or internal urethrotomy the patient is placed in the prone position on the table. The lithotomy position is used for external urethrotomy or other operations on the perineal or posterior urethra. The pubic area, external genitals and perineum are shaved, washed with green soap and water and sponged off with a disinfecting solution. Tincture of Metaphen or some similar preparation is preferable to tincture of iodine because of its irritating effect in this area. For meatotomy or internal urethrotomy shaving is not necessary. The urethra and the bladder when possible should be thoroughly irrigated with a warm antiseptic solution and the bladder left moderately distended with the solution.

Anesthesia.—Minor procedures such as meatotomy are done under local anesthesia. Spinal anesthesia is more satisfactory for most operations upon the urethra. Only a small amount of Novocain is required and absolute relaxation is assured. In children and apprehensive adults, inhalation anesthesia should be used. Pentothal Sodium is satisfactory for short operations

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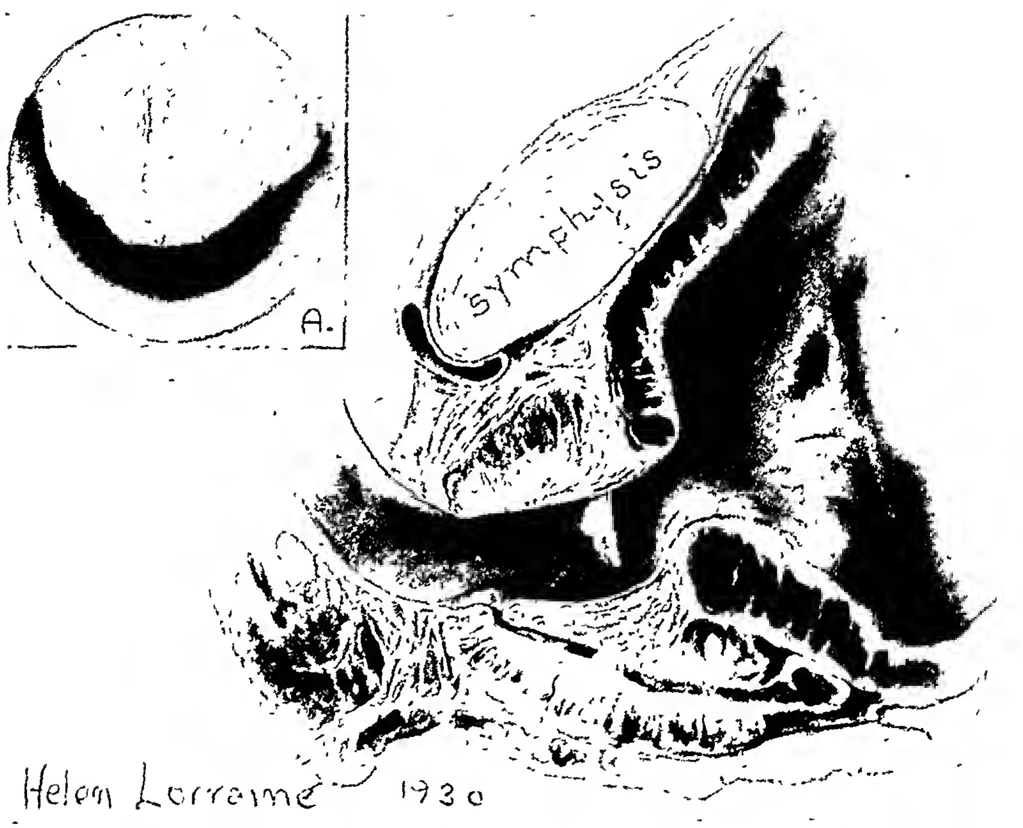

Fig 419—Congenital valve of the posterior urethra. Insert A, Cystoscopic appearance of posterior urethra (Dodson Virginia Medical Monthly, May, 1931)

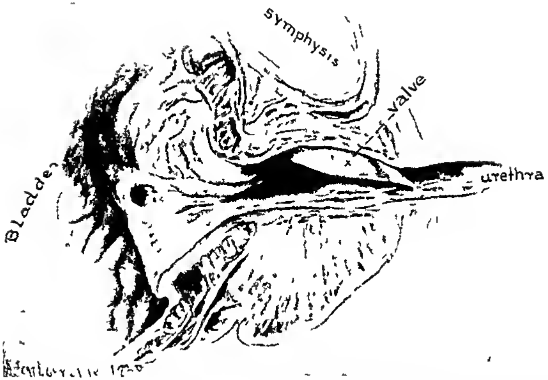

Fig 420—Congenital valve of posterior urethra extending from internal sphincter area beyond the verumontanum Child twelve years of age Megaloureter and hydronephrosis of left kidney from back pressure (Fig 8?) (Dodson Virginia Medical Monthly May 1931)

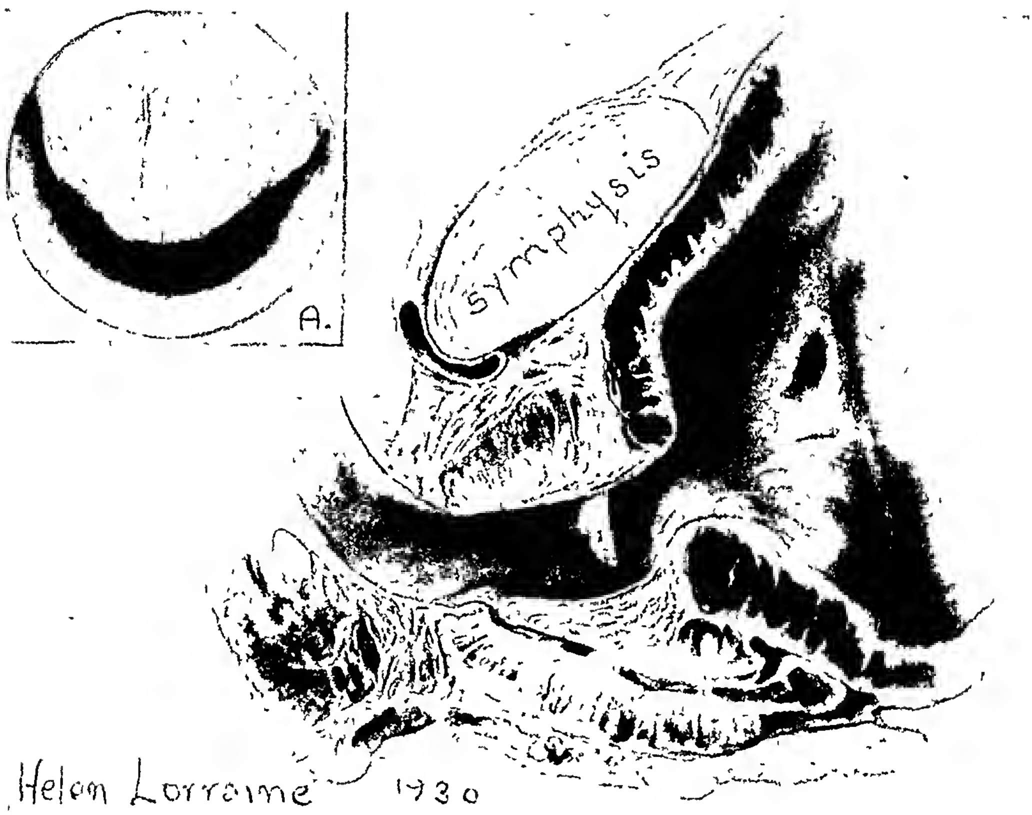

Fig 419—Congenital valve of the posterior urethra Insert *A*, Cystoscopic appearance of posterior urethra (Dodson Virginia Medical Monthly, May, 1931)

urethra is now placed in the bottom of this wound and fixed by sutures A catheter is laid in the urethra and the skin of the urethra is sutured over it The corpora cavernosa are brought together by a few sutures and the skin is closed over them in the usual manner The illustrations show the steps of the operation (Fig 425) The base of the flap of the urethra is at the root of the penis so that there should be no trouble about the nutrition of this transplanted mucosa of the urethra

The operation of H H Young is similar to Cantwell's operation except that he leaves the flap for construction of the urethra attached for its entire length to one of the corpora cavernosa and after freeing the corpora, rotates this body mesially to bring the urethra to its normal position (Figs 426 432)

Fig 421

Fig 4..

Fig 4.1—Exstrophy of the bladder and epispadias
Fig 4..—Outline of incisions for plastic repair of epispadiac penis

In cases of complete epispadias it is necessary to repair the defects in the sphincters of the bladder A method for successfully repairing the sphincters was published by H H Young in 1922 The bladder is opened suprapubically and a section is removed from the superior part of the bladder orifice extending down through the prostatic urethra In complete epispadias the vesicle sphincter is lacking in this area The dissection is carried down onto the sides of the bladder neck until thick muscle bundles are reached The roof of the

(Text continued on page 583)

CONTRACTURE OF THE INTERNAL SPHINCTER AND HYPERTROPHY OF THE VERUMONTANUM

Contracture of the internal sphincter and hypertrophy of the verumontanum are much less frequently encountered. The pathological changes and symptoms are the same. They are *differentiated from congenital valves by cystoscopic* examination The treatment consists of excision of the obstructing tissue.

An excellent method of correcting pathological conditions of the bladder orifice and posterior urethra in male children is by retropubic exposure. After exposing the anterior surface of the bladder and prostate, a longitudinal incision is made extending from the bladder into the prostatic urethra. The incision should be only long enough to expose the trigone, bladder orifice and posterior urethra, and about twice as long in the bladder as in the prostatic urethra. By gentle retraction the area can be observed and obstructive lesions excised. Bleeding is controlled by clamping and fulgurating the area, and the incision is closed transversely, thereby bringing the bladder wall into the sphincter area to prevent contraction In the experience of those who have used this method, final results are more satisfactory than when obstructive lesions are removed transurethrally.

In female children a suprapubic approach may be used to correct obstruction at the bladder orifice. I would hesitate to extend an incision into the urethra for fear of incontinence.

EPISPADIAS

The surgical requirements in the treatment of epispadias vary according to the extent of the deformity (Figs 421 through 442). In the incomplete cases operations are required to repair the defect and correct the malposition of the urethra and the deformity of the penis. In complete epispadias it is also necessary to reconstruct the sphincters of the bladder or, failing in this, to transplant the ureters into the sigmoid.

In the simpler forms the operation of Cantwell is probably the most satisfactory. This method depends upon the fact that in this disease the two corpora cavernosa are much more loosely attached to each other than in a normal penis and can be readily separated The first step in this as in any plastic operation on the penis is to provide for drainage of the bladder, either through the perineum or suprapubically, in order to divert the stream of urine while the wound in the penis is healing. The perineal operation is best here and can be quickly done by a short incision through the perineum on a sound in the urethra. On each side of the groove of the epispadias that represents the urethra an incision is made along the junction of the mucosa and the skin from the symphysis to the extremity of the glans These incisions extend down to the corpora cavernosa but not into them. The urethra is freed as a flap from its bed and is then held up while the two corpora cavernosa are separated from each other until the skin on the lower surface of the penis is reached. The mobilized

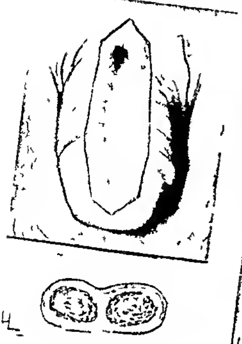

Fig 426

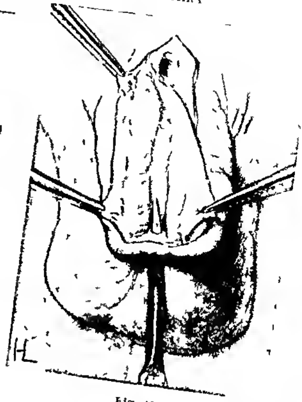

Fig 427

Fig 428

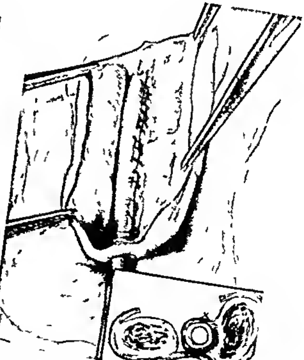

Fig 429

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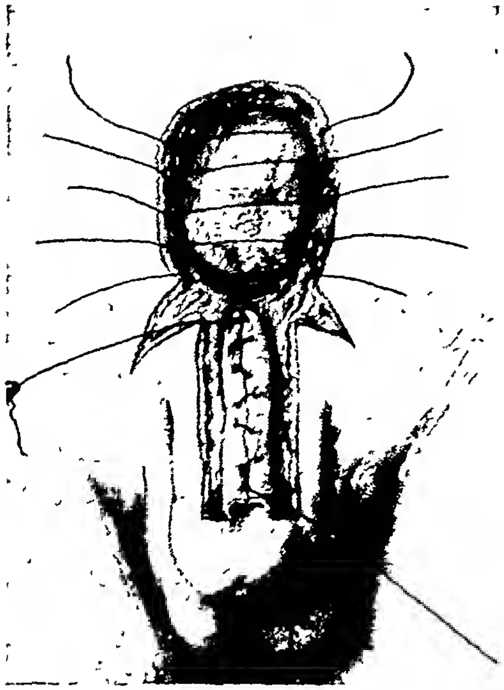


Fig 423.

Fig 424

Fig. 423.—The bladder has been excised and interrupted sutures of chromic catgut have been placed through muscles and fascia to close defect in abdomen Urethra has been formed from skin covering groove on the penis.

Fig. 424—Operation for excision of bladder and correcting the deformity of the penis completed The skin is closed with interrupted sutures of stainless steel

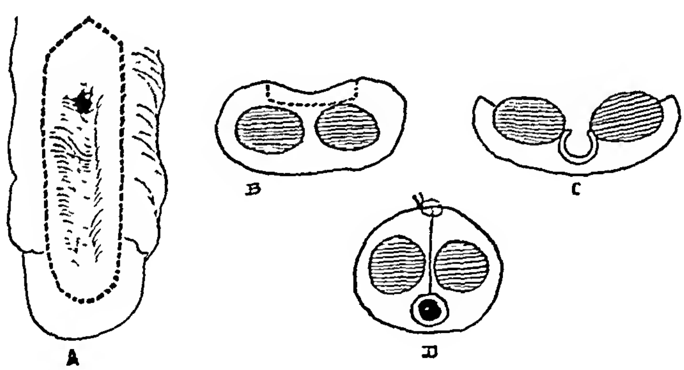


Fig. 425.—The operation of Cantwell for epispadias *A* shows the epispadias, with the dotted line indicating the incision for the formation of the urethra. *B* shows the relation of the skin flap which is to form the new urethra The corpora are not firmly attached to each other in epispadias. *C*, The flap for the urethra is made and is sunk between the two corpora, which are easily separated in this deformity. *D*, Cross section representing the operation completed.

Fig. 426—Plastic operation for correction of incomplete epispadias Incision is outlined along the margins of the groove on the dorsum of the penis Insert Illustrates cross section of the penis

Fig 427—The skin flap is dissected up, leaving it attached throughout its length to the left corpora cavernosa A stab wound is made through the glans penis near the ventral surface

Fig. 428—The newly formed urethra is sutured to the skin margin of the incision through the glans

Fig 429.—The corpora have been separated and the flaps sutured over a small catheter The corpus to which the newly formed urethra is attached is rotated inward, carrying the urethra near the ventral surface of the penis

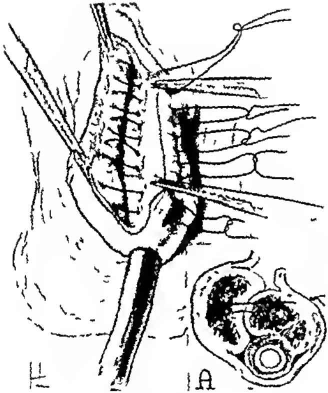


Fig 431

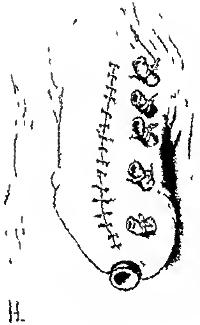


Fig 432

Fig 431.—Second layer of sutures uniting the corpora. These are nonabsorbable mattress sutures preferably silver wire or stainless steel and pass from the skin on one side of the penis and include the fibrous sheath of both corpora. Insert A shows two layers of sutures and relation of urethra to the corpora.

Fig 432.—The operation completed. Interrupted sutures tied over small rubber tubing and skin closed with a continuous suture of silk or cotton.

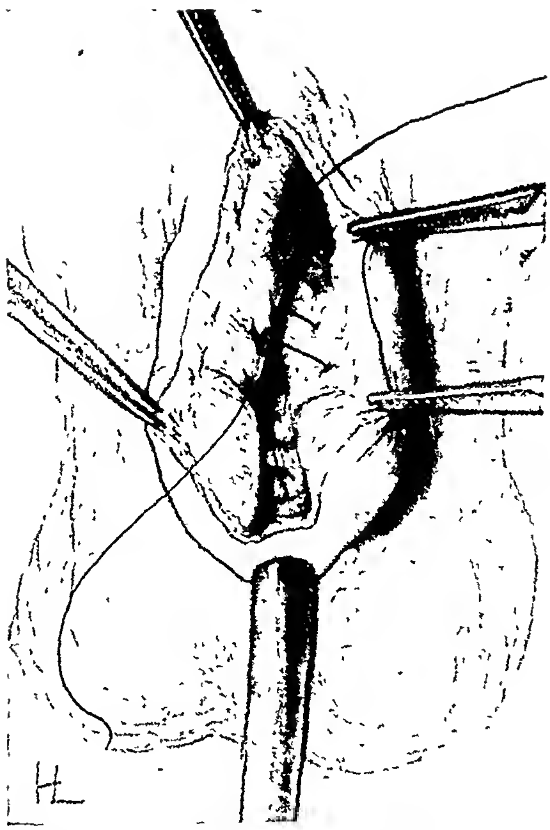


Fig 430.—The urethra in place. The corpora are sutured together with No 0 chromic or tanned catgut.

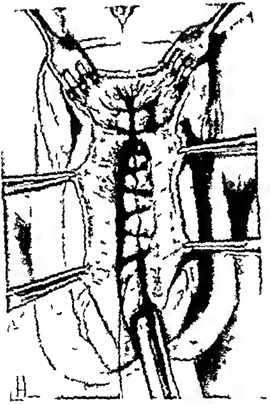


Fig 435

Fig 436

Fig 435—The new urethra has been formed by suturing the margins of the skin flap with a continuous suture which does not perforate the flap and is placed so that the skin margins are turned inward Two deep sutures of fine kangaroo tendon are taken in the upper angle of the wound uniting the external sphincter muscle

Fig 436—The corpora cavernosa are sutured together over the newly formed urethra The sutures are taken so that the left corpus is rotated carrying the urethra to the ventral portion of the penis Closure of the wound is completed by interrupted sutures of fine steel wire supplemented by fine silk sutures through the skin The catheter is fixed to the prepuce with a suture of fine chromic catgut

Fig 433

Fig 434

Fig 433 —Complete epispadias with incontinence of urine A cystostomy has been done for drainage of the bladder and a flap is outlined for restoration of the urethra

Fig 434 —The urethra is being dissected from the right corpus cavernosa

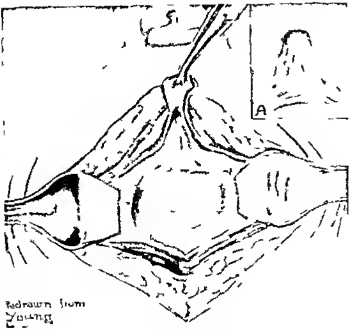


Fig 439 —Young's operation for the cure of incontinence associated with epispadias The bladder is widely opened and a triangular section is removed from the anterior portion of the prostatic urethra

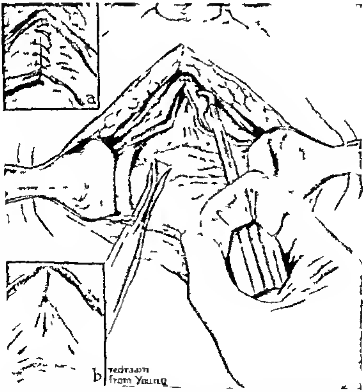


Fig 440 —Operation for cure of epispadias prostatic urethra being closed The closure after the method of Young leaves a normal internal vesical orifice

Fig 437 —Exstrophy of the bladder with complete epispadias Scar on abdomen from abdominal incision for transplantation of the ureters into the sigmoid.

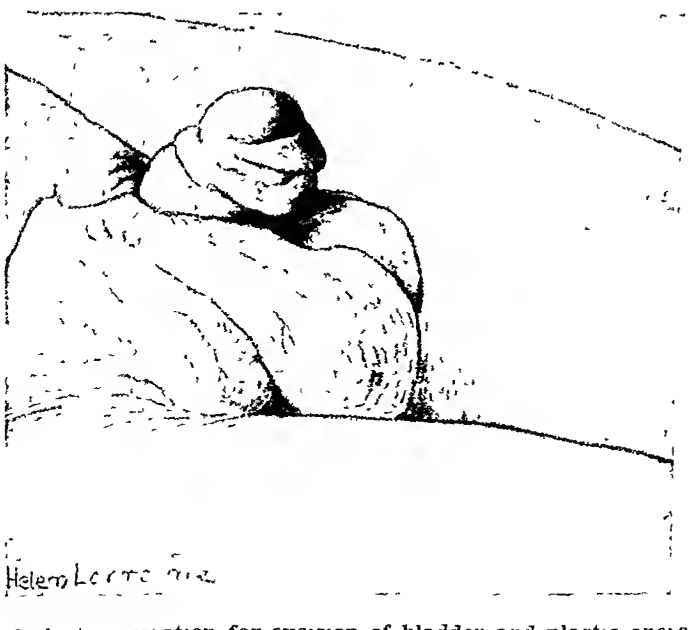


Fig 438 —Result of plastic operation for excision of bladder and plastic operation on the penis

prostatic urethra and of the bladder orifice is then closed, including the muscle, which is sutured together in the midline In this way the bladder orifice is reduced to a normal state The wound in the bladder is closed, leaving a suprapubic tube for drainage The external sphincter is repaired from below The mucous membrane from the roof of the membranous urethra is dissected off to the prostatic urethra and sutures are placed to construct the lumen of this portion of the urethra, bringing together in the midline above the more developed portions of the external sphincter (Figs 439 442)

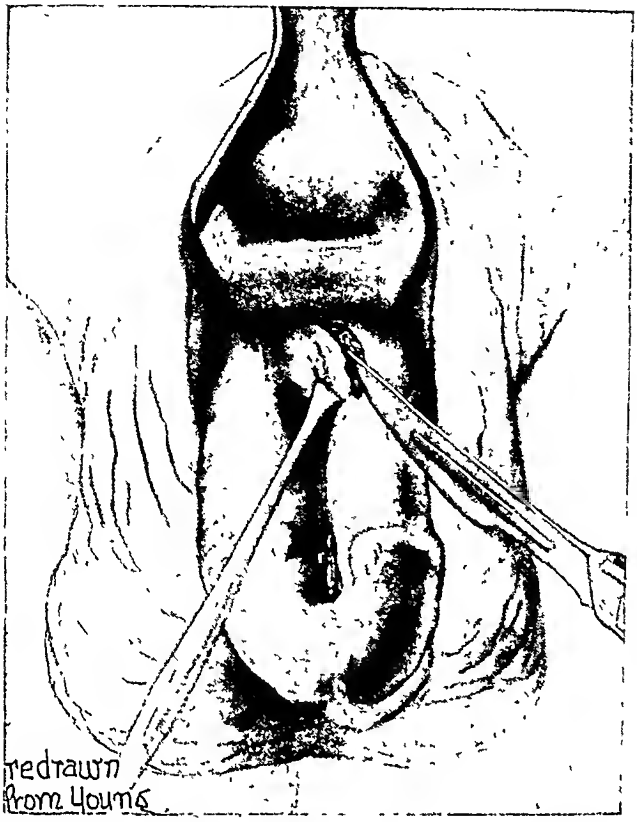
HYPOSPADIAS

Hypospadias occurs once in about every 300 births and may vary from the simplest type of deformity, in which the meatus is situated just in front of the frenum with practically no downward curvature of the penis, to a condition so severe that it may be difficult to determine immediately the sex of the child It is natural, therefore, that the parents are greatly concerned and that if the condition is not corrected the child in later life may have difficulties in adjusting himself to society

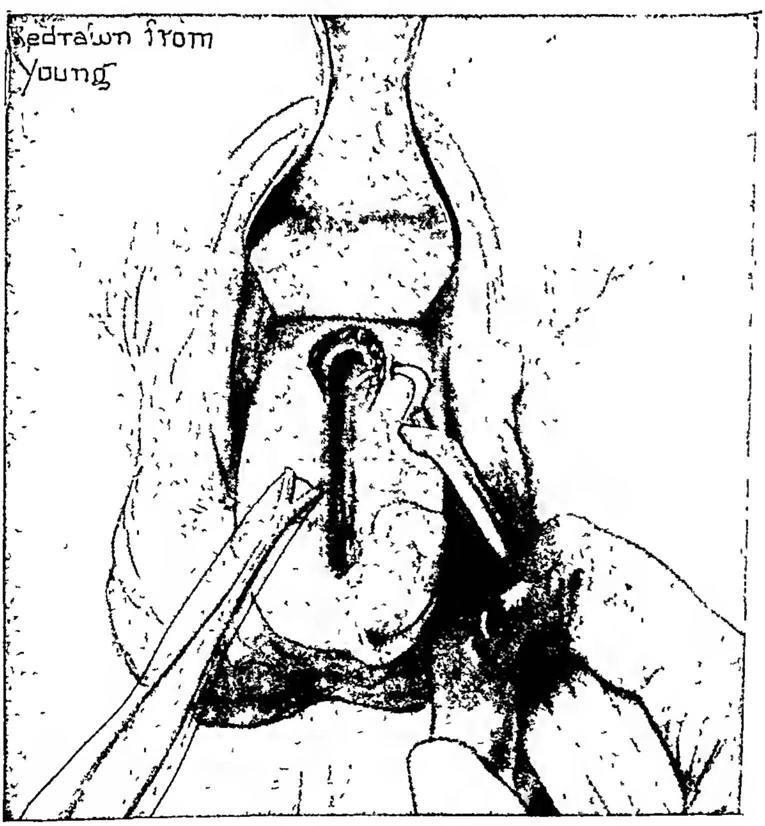
Before beginning the treatment it is well to discuss with the parents the operative procedures involved and the results expected They should be advised that the excision of scar tissue will liberate the hypospadiac opening and cause it to be situated further posteriorly They should be acquainted also with the fact that several operations may be necessary before a complete cure is obtained In this way much dissatisfaction may be avoided When the downward deformity has been completely corrected the child will develop normally and plastic procedure for the formation of an anterior urethra can be taken care of at a later date When possible, all plastic procedures should be completed by the time the child is six years old or before he starts to school Children are much more apt to behave normally and will not so frequently develop personality problems when they are not handicapped by deformities or disturbances that make them in any way different from other children

There is some difference of opinion as to the optimum age for undertaking plastic correction It seems preferable to begin the operative procedures early This of course depends somewhat upon the growth and the health of the child but in most instances the first operation should be done by the time the child is two years of age In most cases there is a downward curvature of the penis which usually varies with the extent of the hypospadias The type in which the hypospadiac opening is situated at or behind the penoscrotal junction is accompanied by a much more severe deformity than one in which the opening is situated further forward

The first step in treatment consists of dissecting out the bands of scar tissue which bind the penis downward The operation is begun by making a transverse incision in the skin on the undersurface of the penis a short distance beyond the hypospadiac opening (Fig 443 1) Buck's fascia is divided



ig. 441 —Operation for cure of epispadias. The roof of the membranous urethra is being excised through the epispadias opening



ig. 442 —Operation for cure of epispadias Suturing the roof of the membranous urethra to tighten the external sphincter.

transverse suture, making "dog ears," they may be trimmed off (Fig 448) Indwelling catheter drainage is maintained for about forty eight hours This method of correcting the deformity of the penis also provides abundant skin on the ventral surface of the penis for construction of a new urethra

When construction of the urethra is begun, the urine must be diverted from the field of operation by either perineal urethrostomy or suprapubic cystostomy In perineal hypospadias the hypospadiac opening serves for drainage until the urethra has been constructed to within about one half of an inch (1 75 cm) of the opening Then a suprapubic cystostomy is done for drainage and the perineal defect is closed When the urethra opens anterior to the perineum, a perineal urethrostomy is the best method of drainage When the operation is to be done in stages, a permanent urethrostomy may be made by extending the incision in the urethra for about one half inch (1 75 cm) and suturing the mucous membrane to the skin (Fig 451) This is not difficult in children where the urethra is near the surface With this procedure it is not necessary to keep a catheter in place until the wound has healed, consequently, there is less danger of infection of the urinary tract, and a repeated urethrostomy is avoided The fistula is easily closed by separating the mucous membrane from the skin and suturing the opening with interrupted sutures of silk or chromic catgut

Plastic operations for the correction of hypospadias often fail because the principles underlying all plastic surgery are neglected Absolute asepsis during the following operation is essential In addition to cleansing the skin thoroughly, the hypospadiac urethra, a frequent source of infection, must be kept clean The premature passage of urine through the newly formed urethra caused by stoppage of the perineal drainage tube, is a frequent cause of infection and breaking down of the sutures This may be prevented by placing a silkworm gut suture around the urethra just in front of the urethrotomy and tying it just tightly enough to occlude but not cut through the urethra (Fig 450)

Another frequent cause of failure is incomplete hemostasis Wherever there is the slightest bleeding, the points must be ligated In no instance should one trust to the placing of sutures or to pressure to control minute bleeding points Wherever blood clots form, sinuses are apt to occur

In outlining flaps and grafts, it is important to remember that the skin of the penis and scrotum shrinks considerably when dissected free Efforts to construct and to cover the urethra with inadequate skin flaps result in excessive tension on the sutures and interference with the blood supply along the line of sutures and are followed by slough and complete failure or by the formation of fistulas An adequate blood supply is most important A broad pedicle should be left for the nourishment of flaps which should be dissected just far enough to permit accurate approximation without tension The least complicated operations are more apt to be successful The flap should have a broad base and should be constructed from the skin of the penis itself when it is possible If the roof of the urethra is left attached along the surface of the penis, there is no doubt that the canal will develop with the development of the penis

and all constricting bands of scar tissue are dissected away from beneath the the hypospadiac opening to the base of the glans penis (Fig. 443*B*). These bands of fibrous tissue are situated mostly between and along the ventrolateral margins of the corpora cavernosa. The dissection should extend back beneath the terminal portion of the urethra for a short distance In advanced degrees of hypospadias, it is better to make two transverse incisions, one just anterior to the hypospadiac opening and the other posterior to the base of the glans penis. When the dissection has been completed, all bleeding is carefully controlled and the fascia and the skin are closed in the opposite direction of the incision. If the skin appears to constrict the penis, short, longitudinal incisions may be made on the dorsal surface and sutured in the opposite direction, thereby relaxing the skin. This aids in healing and has a tendency to shift skin from the dorsal to the ventral surface of the penis for future need in constructing the urethra.

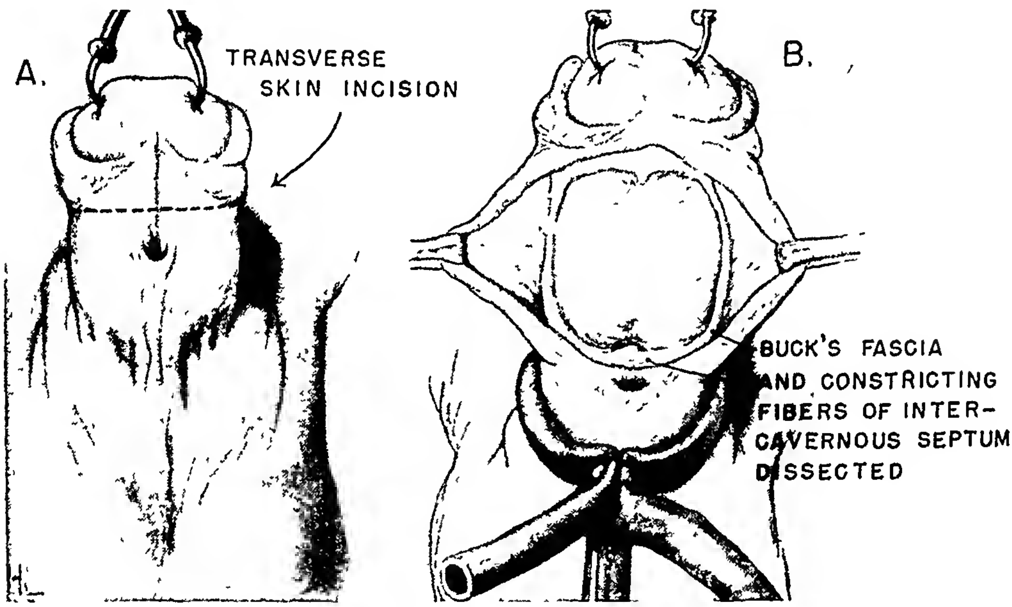


Fig 443 —(A) Transverse incision just distal to hypospadiac orifice to expose constricting bands (*B*) Constricting adhesions have been dissected from ventral surface of penis Note posterior displacement of hypospadiac orifice Skin is now closed in longitudinal direction

Reed M. Nesbit has devised a method of transferring the redundant skin of the dorsum of the penis to the ventral surface at the same time the ventral deformity is corrected. An incision is made around the penis about 0.5 cm from the corona (Fig 444). By subcutaneous dissection the skin is stripped back from the phallus (Fig 445). On the ventral surface, all fibrous elements are completely removed by sharp dissection, correcting the ventral curvature of the penis A buttonhole incision is now made in the dorsal skin flap at a suitable point (Fig 446) and the glans penis is brought through this opening (Fig 447). The edges of the buttonhole incision are sutured to the skin adjacent to the corona by interrupted sutures (Fig. 448) The skin flap distal to the buttonhole incision covers the denuded ventral surface of the penis, and is sutured to the retracted skin margin by a row of transverse sutures (Fig. 449). If there are excessive amounts of skin at the extremities of the

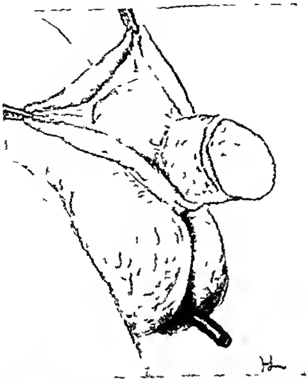


Fig 446—A buttonhole incision i made through the dorsal skin to permit the redundant portion of the skin to be transferred to the ventral surface of the penis

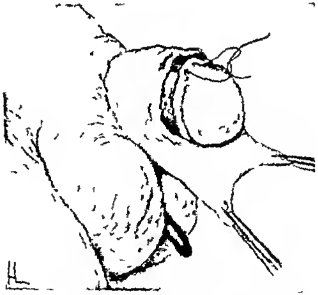


Fig 447—The glans is pulled through the buttonhole and the margin of the buttonhole sutured to the skin margin posterior to the glans

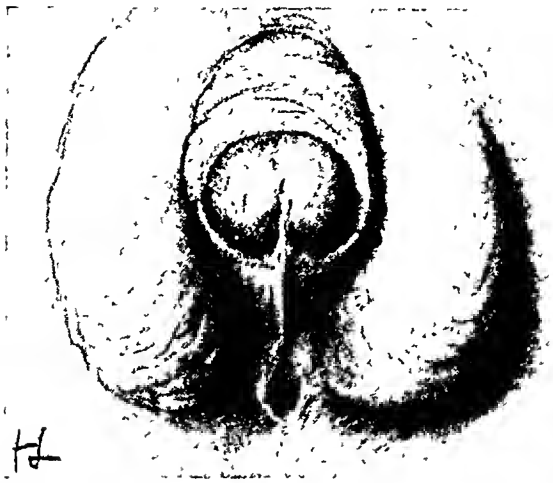


Fig 444—Reed M Nesbit's method of straightening the penis in the treatment of hypospadias Dotted line indicates incision in skin of penis behind the glans

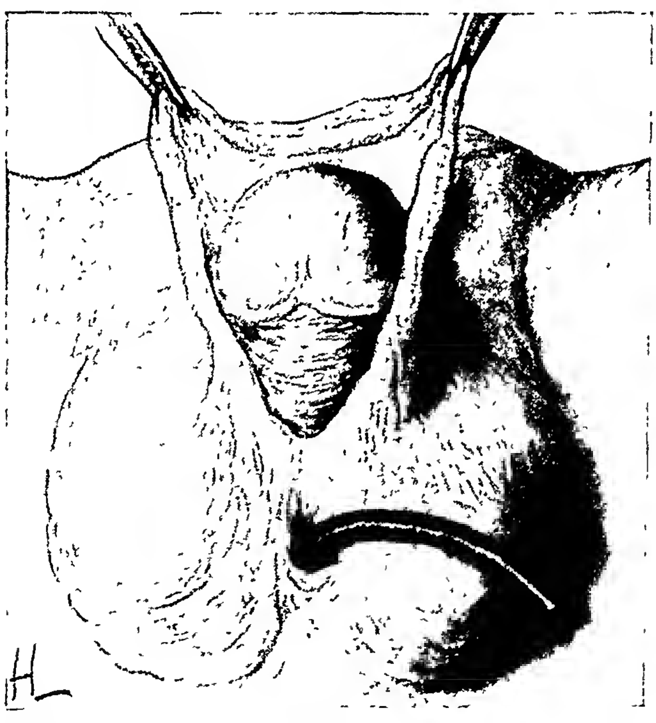


Fig 445—The skin of the penis has been divided behind the glans and retracted backward while the fibrous constricting bands are dissected from the ventral surface of the penis

These principles are embodied in the Thiersch method of reconstructing the urethra. Flaps for forming the urethra are outlined along the ventral surface of the penis by parallel incisions about one half inch (1.75 cm.) apart, beginning at the base of the glans and extending just posterior to the hypospadiac opening, and these incisions are joined posteriorly by a transverse incision (Figs 452 and 453). One of the longitudinal incisions is located nearer the midline than the other and the skin used to form the ventral surface and lateral walls of the urethra is dissected from the side of the broadest flap; on the other side the skin is dissected just far enough to be readily sutured to the

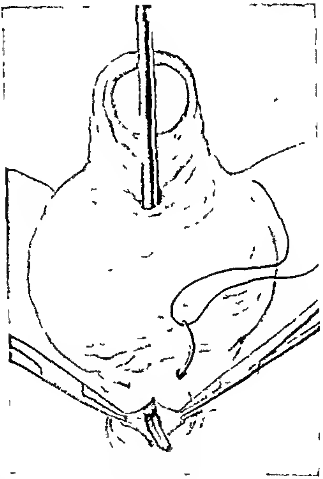


Fig. 450.—A suture is being placed around the urethra to prevent urine from entering the anterior urethra until the wound is healed. The suture is tied just tightly enough to occlude the urethra.

other flap (Fig. 454). The roof of the newly formed urethra forms the base of the pedicle. The flaps are so sutured with interrupted or continuous sutures of 000 chromic catgut that the skin margins will be turned into a newly formed urethra (Figs. 455 and 456). The flap for covering the urethra is taken from the opposite side of the penis opposite the site of the larger flap and when brought across and sutured, broad flat surfaces are approximated and the lines of sutures are not opposite each other (Figs. 457 and 458). In this way fistulas are less likely to occur. Suturing of the transverse incision posterior to the

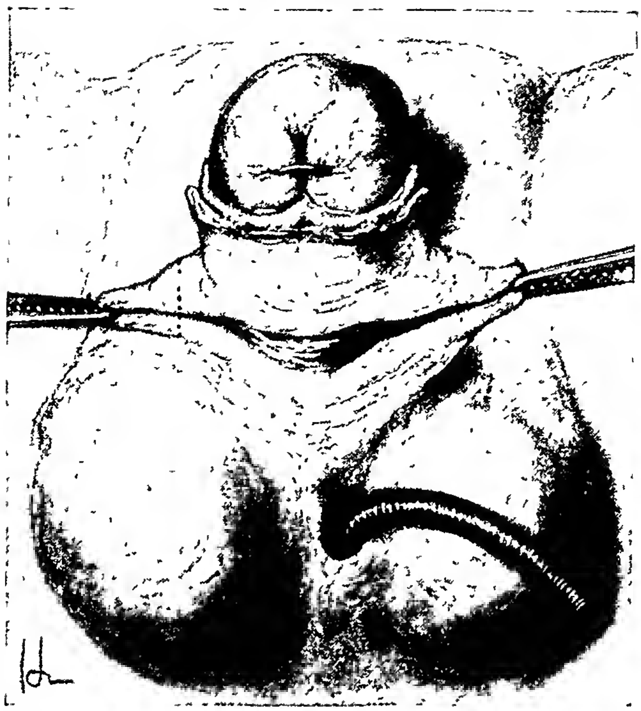


Fig 448—The flap of the skin distal to the buttonhole incision is sutured to the retracted skin margin on the ventral surface of the penis Dotted lines indicate the point at which "dog ears" are excised

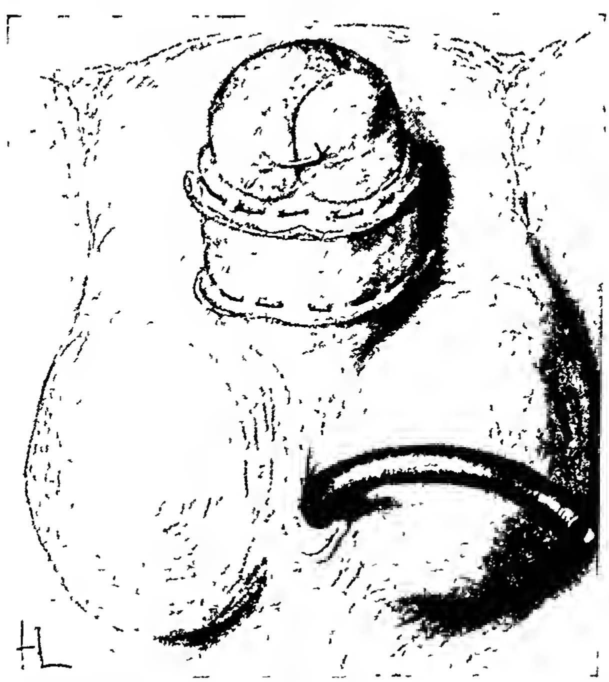


Fig 449—The completed operation An abundance of skin is provided on the ventral surface of the penis for future use in forming a urethra

hypospadiac opening completes the operation The urethra may be carried through the glans at a later operation by utilizing a tube constructed from the prepuce This is not necessary, however, since the meatus at the base of the glans functions quite satisfactorily

The most satisfactory method of carrying the urethra to the end of the penis is the use of the pedicled tube graft devised by D M Davis A rectangular flap of skin is outlined on the dorsum of the penis with the pedicle at the proximal end The edges of the flap are made to diverge slightly as the pedicle is approached so that the new meatus will be sufficiently large (Fig 459) With the pedicle of the tube graft toward the base of the penis, the blood supply is

Fig 458 —The outline of flaps for construction of the anterior urethra by the Thiersch method

adequate and the graft can be made as long as the length of the penile skin will allow If there is considerable dorsal prepuce, as is usual in hypospadias, most of the tube graft can be formed from the prepuce The proximal attachment allows the penis to be bent over dorsally so that the entire length of the tube graft can be utilized The length of graft desired is determined by measuring from the tip of the glans penis to the point on the ventral surface of the penis that the tube is expected to reach The flap outlined on the dorsum of the penis is dissected up and a tube constructed by approximating the lateral margins with a continuous suture of fine plain catgut (Fig 460) With a sharp

(Text continued on page 595)

Fig 451 —External urethrostomy with the mucous membrane of the urethra sutured to the skin to prevent closing When the deformity has been corrected, the mucous membrane is separated and the wound is closed

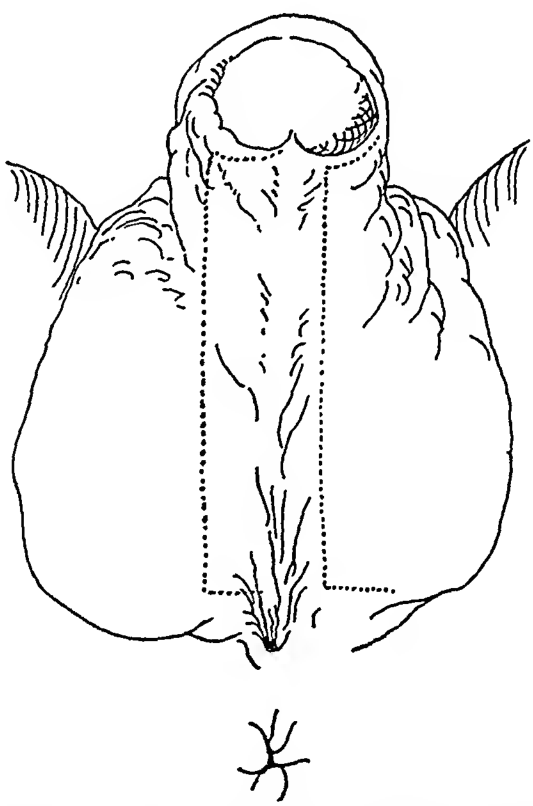


Fig 452 —Outline of skin flaps for the cure of perineal hypospadias by the Thiersch method The perineal opening is left for drainage until the anterior urethra has been constructed

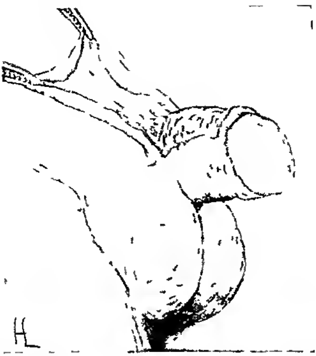


Fig 459.—Method of forming pedicle tube graft for the treatment of hypospadias devised by David M Davis A skin flap is dissected from the dorsum of the penis with the base toward the proximal end

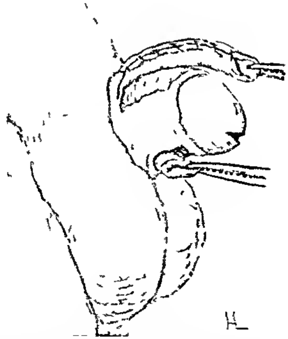


Fig 460.—A tube is constructed from the flap the distal end of the hypospadiac urethra is dissected free and a tunnel is made through the glans penis to the end of the urethra

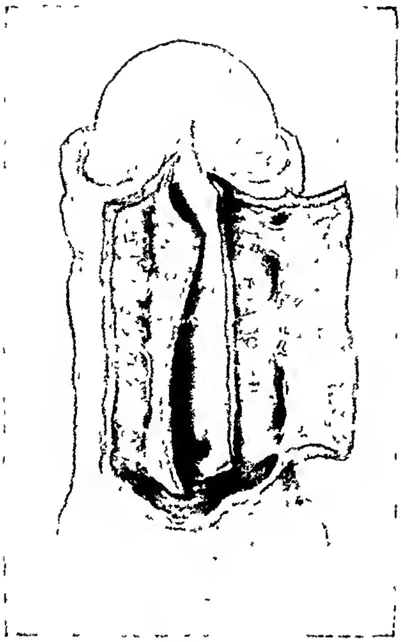


Fig 454

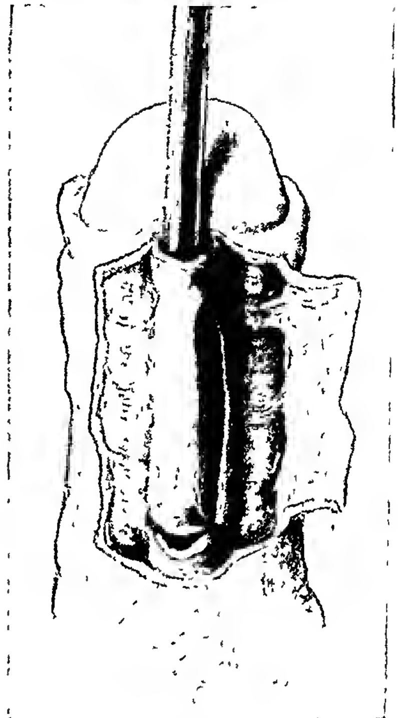


Fig 455

Fig 454—The flaps are dissected up, leaving a broad base attached to preserve the blood supply

Fig 455—The largest side of the central skin flap is sutured over a catheter to the opposite side, which has been dissected just far enough for accurate suturing.

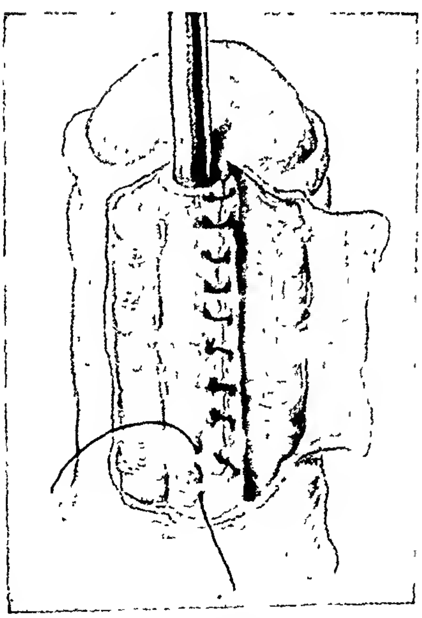


Fig 456.

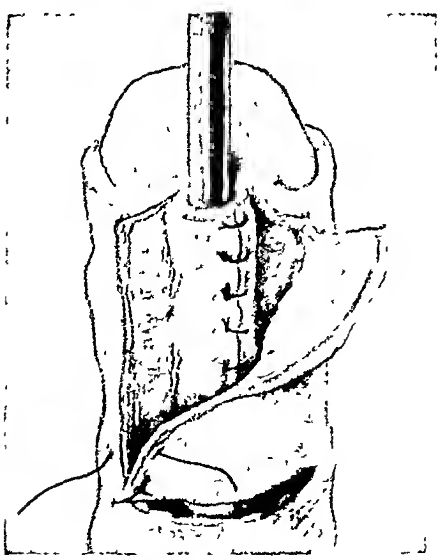


Fig 457

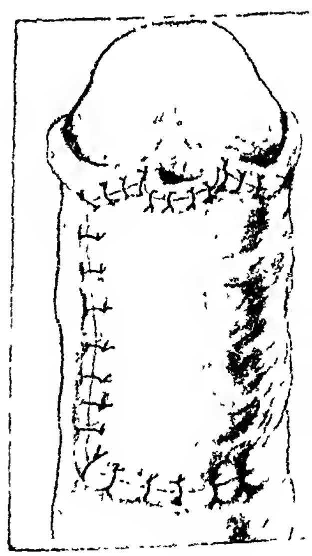


Fig. 458

Fig 456—The new urethra completed by a continuous suture of No 00 chromic catgut The skin margin is turned into the urethra

Fig 457—The lateral flap is brought over the urethra and sutured to the skin margin on the opposite side

Fig. 458—The completed operation.

pointed bistoury a tunnel is produced from the tip of the glans penis to the ventral surface of the penis and is enlarged by a grooved director and scalpel until the tube can be easily drawn through it (Fig 462) Bleeding is controlled by the pressure of the graft The graft is fastened in place by four sutures of fine plain catgut joining its extremity to the skin and three sutures at the new meatus If the operation is to be completed at one sitting the tube graft is anastomosed to the original urethra where it ends at or near the phrenal area When the tube graft does not reach the original urethral orifice, the construction of the urethra may be completed by a Thiersch plastic at the same time or at a later operation (Fig 461) The penis is held in the antiflexed position by a firm bandage which is not disturbed for four or five days The bladder is drained by a catheter passed through the existing urethral orifice or through a perineal urethrotomy opening if the tube graft is anastomosed to the existing urethra

The pedicle may be divided in about two weeks, leaving the urethral meatus normally situated at the tip of the glans The puckered scar that is left on the dorsum of the penis practically disappears within twelve months

An operation that can often be done and which gives satisfactory results is that of C H Mayo After straightening the penis the wound is allowed to heal and at the second operation a large tunnel is made through the glans penis to a point a little to one side of the site of the normal opening A flap long enough to reach without tension through this tunnel in the glans to the urethral opening is cut from the dorsal surface of the penis and prepuce with its base at the anterior margin of the prepuce It must be wide enough to be rolled into a tube of about the size of a normal urethra It is sutured together as a tube with the skin surface inside, using fine sutures of tanned or chromic catgut This tube is drawn through the tunnel in the glans, and the tip is sutured to a bed prepared for it close to the urethral opening The tube is allowed to heal in position and after an interval of a few weeks the base of the flap is cut A few weeks later this tube made from the transplanted fold of prepuce is united to the end of the urethra

The Dennis Brown operation (Figs 463 and 464) is to some extent similar to the Thiersch procedure in that a strip of skin is isolated by parallel incisions along the ventral surface of the penis the incisions joining just posterior to the hypospadiac opening In this operation the incisions are equidistant from the midline It differs from the Thiersch operation in that the isolated strip of skin is not formed into a tube but is buried with no attempt to sew the edges together Skin flaps are then raised widely on either side preferably by divulsion with blunt scissors so that they may be approximated without the slightest tension Dennis Brown advises that a longitudinal incision be made on the dorsum of the penis to further relax the skin flaps This incision is spread widely apart and allowed to heal by epithelization This dorsal incision also serves to lessen edema Additional incisions or stab wounds should be made from the inner raw surface out through the skin to aid the free flow of serum

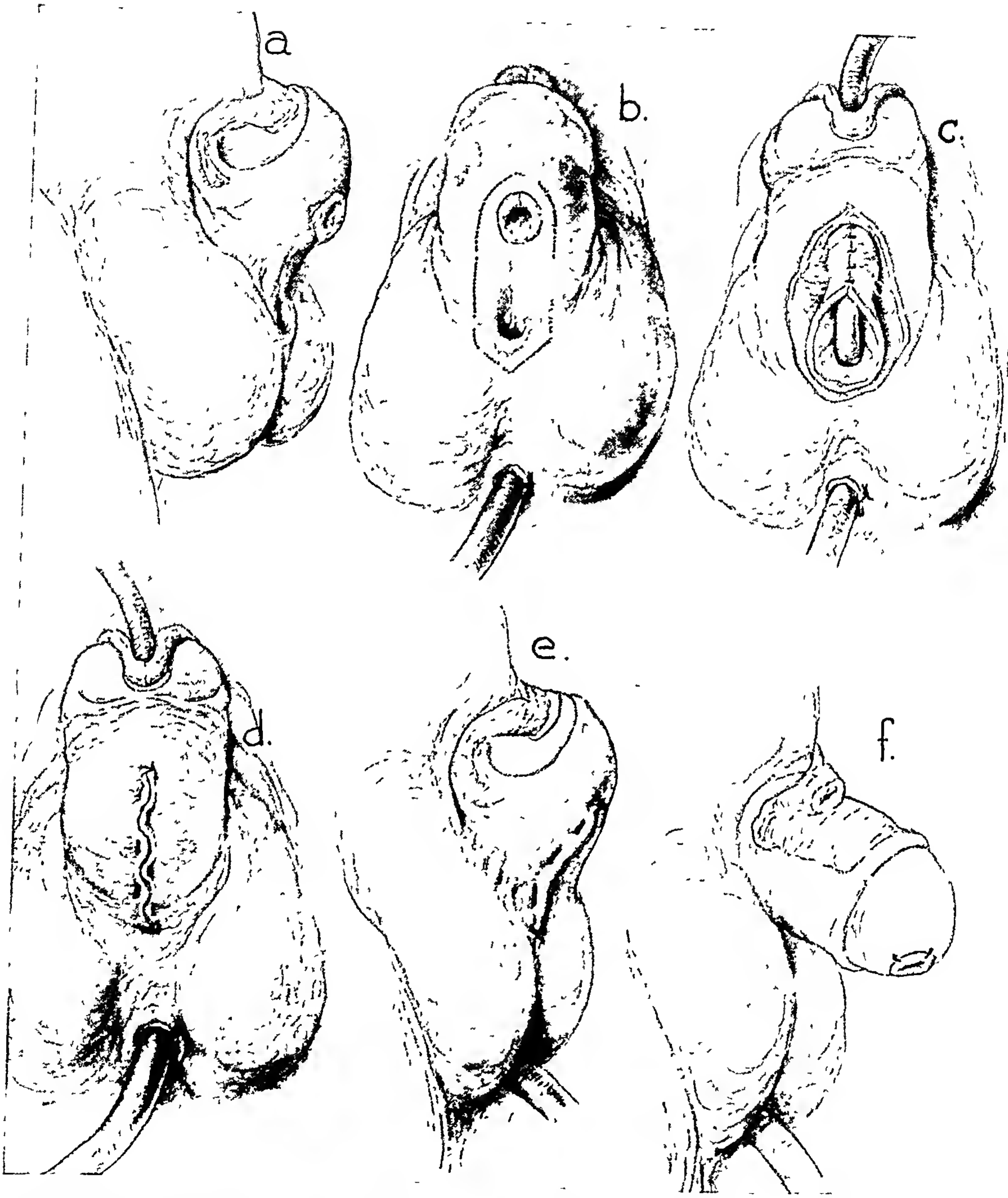


Fig 461 —The different steps in combining the operations of D M Davis and Thiersch for correction of penoscrotal hypospadias *a* Tube graft drawn through the glans penis *b* Orifices of tube graft and hypospadiac urethra with outline for forming the remaining portion of the urethra *c.* Urethra partially sutured *d* Closure of urethra is complete *e* Lateral view of same *f* Tube graft has been excised

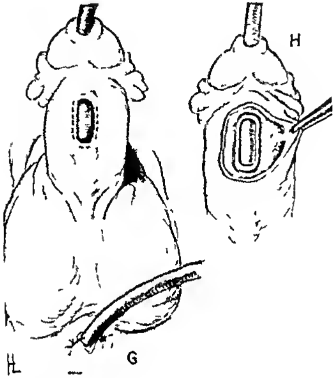


Fig 463.—(G) The combined Davis Dennis Brown operation The Davis tube has been constructed and sutured in place (Fig 46) A catheter is passed into the urethra and a strip of skin outlined (H) Skin and fascia are being dissected up to close the defect anteriorly

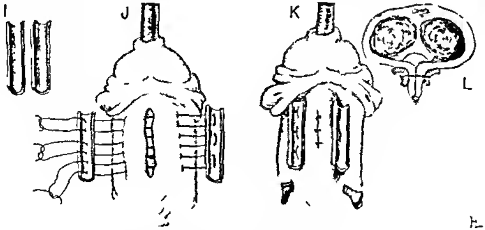


Fig 464.—(J) Relaxing sutures placed through strips of rubber in place of bead as used by Dennis Brown (K) Sutures tied over rubber strips and skin margins accurately approximated (L) Cross section showing buried skin strip

Adequate skin flaps having been formed, the active bleeding areas are clamped and ligated. In this operation it is not necessary to obtain a perfectly dry field. The mucous membrane is then excised from the ventral surface of the glans penis on either side of the midline to the point where the meatus is to be located.

The success of the operation depends upon an accurate union of the skin edges along the ventral line of suture. This is accomplished by keeping all tension off the edges, complete diversion of urine, and extreme accuracy in approximation, a row of tension sutures is placed about a half-inch from the skin margin. These sutures are of fine silk and consist of a single thread which pierces both flaps and is fixed in place by two beads or buttons, held in place on either side by aluminum cylindrical beads which are crushed upon the suture (Fig 464) These sutures are adjusted so that the skin flaps are barely approximated, so as to prevent sloughing from pressure or interference of the circulation of the skin edges.

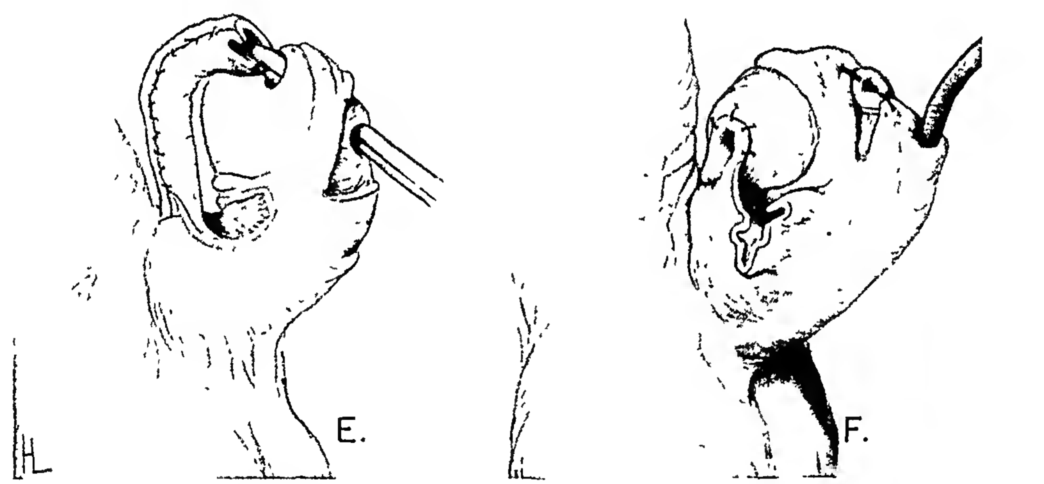


Fig 462.—(*E*) The penis is bent backward and the tube drawn through the tunneled glans penis (*F*) The tube may be sutured to the urethra or, if the hypospadiac opening is situated too far back for an anastomosis to be made, the end of the tube is anchored to the ventral skin surface as illustrated and the construction completed later by the Thiersch or Dennis Brown method When the tube graft has grown in place it is divided at the tip of the glans penis and the defect in the dorsum of the penis permitted to heal

The skin edges are sutured with the finest possible catgut, taking care to avoid inversion or maladjustment When the ventral surfaces of the flaps have been sutured, the raw undersurface of the ends of the flaps is approximated with sutures to the raw surfaces on either side of the new meatus The new urethral passage is formed deliberately as a fistula depending upon the spread of epithelium from the buried skin strip and the healing of tissues around it to form a tube.

In place of the beads to hold the retention sutures in place, I have utilized strips of small rubber tubing to buttress mattress sutures of fine silk with excellent results (Fig 464). I have also combined the Davis tube flap with the Dennis Brown operation which, in my experience, gives a better final cosmetic result. The Davis procedure is carried out at the time the penis is

straightened and the defect is closed at a later operation (Fig 468) This combined procedure places the urethral meatus in a more normal position and obviates the constriction which frequently occurs when the Davis tube is anastomosed directly to the hypospadiac urethra

The operation of Bucknall is useful when the opening is at the penoscrotal area and when there is not sufficient skin on the penis to construct a satisfactory urethra Parallel incisions are made on the ventral surface of the penis, extending from the glans penis to the penoscrotal junction and for an equal distance on the scrotum (Fig 465) The margins of the flaps are dissected up a very short distance, and beginning at the penoscrotal junction the margins of the

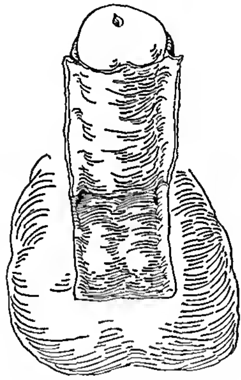


Fig 469

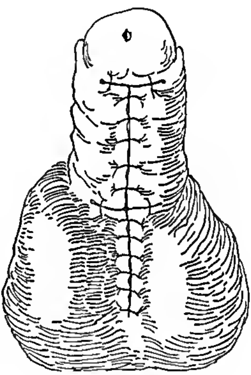


Fig 470

Fig 469—Dissection of skin flaps containing newly formed urethra from the scrotum

Fig 470—The wound on penis and scrotum is closed by a continuous line of fine chromic catgut sutures

flap outlined on the ventral surface of the penis are sutured to those of the flap outlined on the scrotum so that the roof of the new urethra is formed by the skin of the penis and the floor by that of the scrotum The edges of the skin are turned into the urethra (Fig 466) The outer edges of the wound are then closed with interrupted mattress sutures (Fig 467) When the wound has entirely healed, the penis is dissected from the scrotum carrying with it the reconstructed urethra (Figs 468 and 469) The wound in the penis and scrotum is closed in a straight line by interrupted or continuous sutures of chromic catgut or silk (Fig 470)

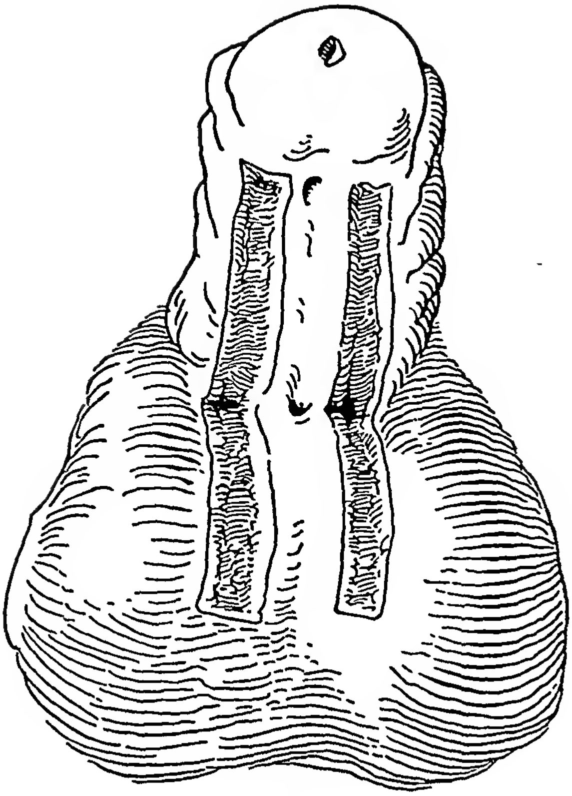


Fig 465

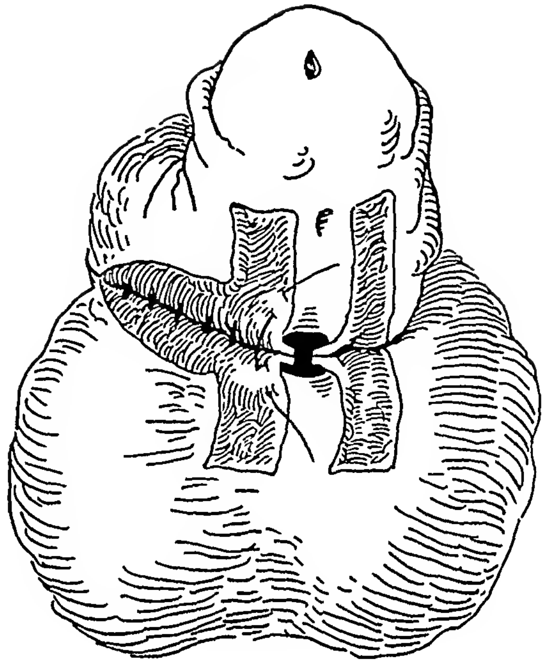


Fig 466

Fig. 465.—The operation of Bucknall for the cure of hypospadias. Parallel incisions are made on the ventral surface of the penis and extending an equal distance on the scrotum.

Fig 466.—The ventral surface of the penis is approximated to the anterior surface of the scrotum, and the flap outlined on the penis is sutured to that of the scrotum, forming a urethra to the end of the penis

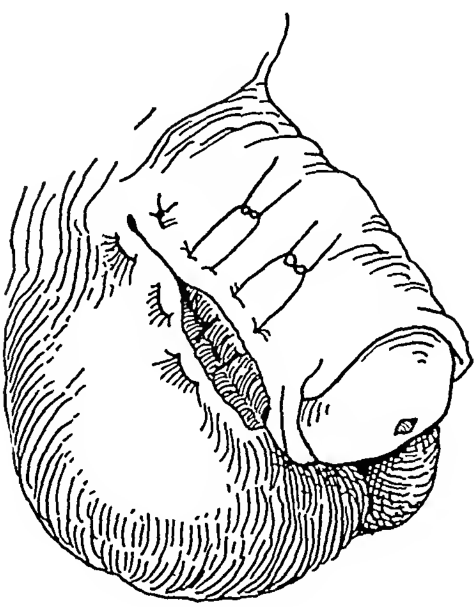


Fig 467.

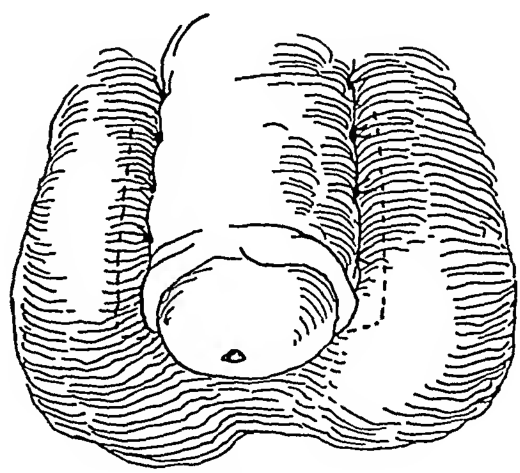


Fig 468

Fig 467.—The external skin margin of the penis is likewise sutured to that of the scrotum.

Fig 468.—Line of incision for dissecting flaps from the scrotum after healing has occurred.

This operation is a sound plastic procedure There is the assurance of adequate blood supply and postoperative fistulas are rare There is the disadvantage that a portion of the urethra is formed from scrotal skin, creating a possible hazard from the growth of hairs in the urethra This disadvantage is overcome by Cecil's modification of the Bucknall operation, in which the urethra is formed from the skin of the penis by dissecting up longitudinal flaps to form a tube A longitudinal incision is then made in the scrotum and the newly formed urethra is buried in the scrotum by suturing the margins of the scrotal incision to the skin of the penis as in the Bucknall operation (Fig 471) When the wound is healed the penis is dissected from the scrotum and the operation completed as in the original Bucknall operation (Fig 472)

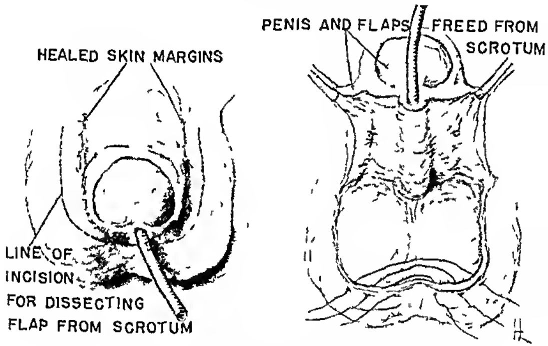


Fig 472—Cecil's modification of the Bucknall operation The urethra is dissected from the scrotum and the operation completed

The Ombredanne Operation

The Ombredanne operation consists of turning up a flap from the anterior surface of the penis and, when necessary, the scrotum by a purse string suture to form a pouchlike urethra The length of the distal portion of the flap AB must be equal to the distance from the hypospadiac opening to the extremity of the glans AC The flap is outlined by a purse string suture of linen or silk, beginning near the midline of the ventral surface of the penis, passing at first outward then forward along one side of the ventral surface of the penis to the tip of the glans and then down on the opposite side to the point where it was originally started The breadth of the flap is equal to one third the circumference of the penis An incision is made through the skin of the penis and mucosa of the glans 1 5 mm external to the purse string suture (Fig 473 1) The proximal

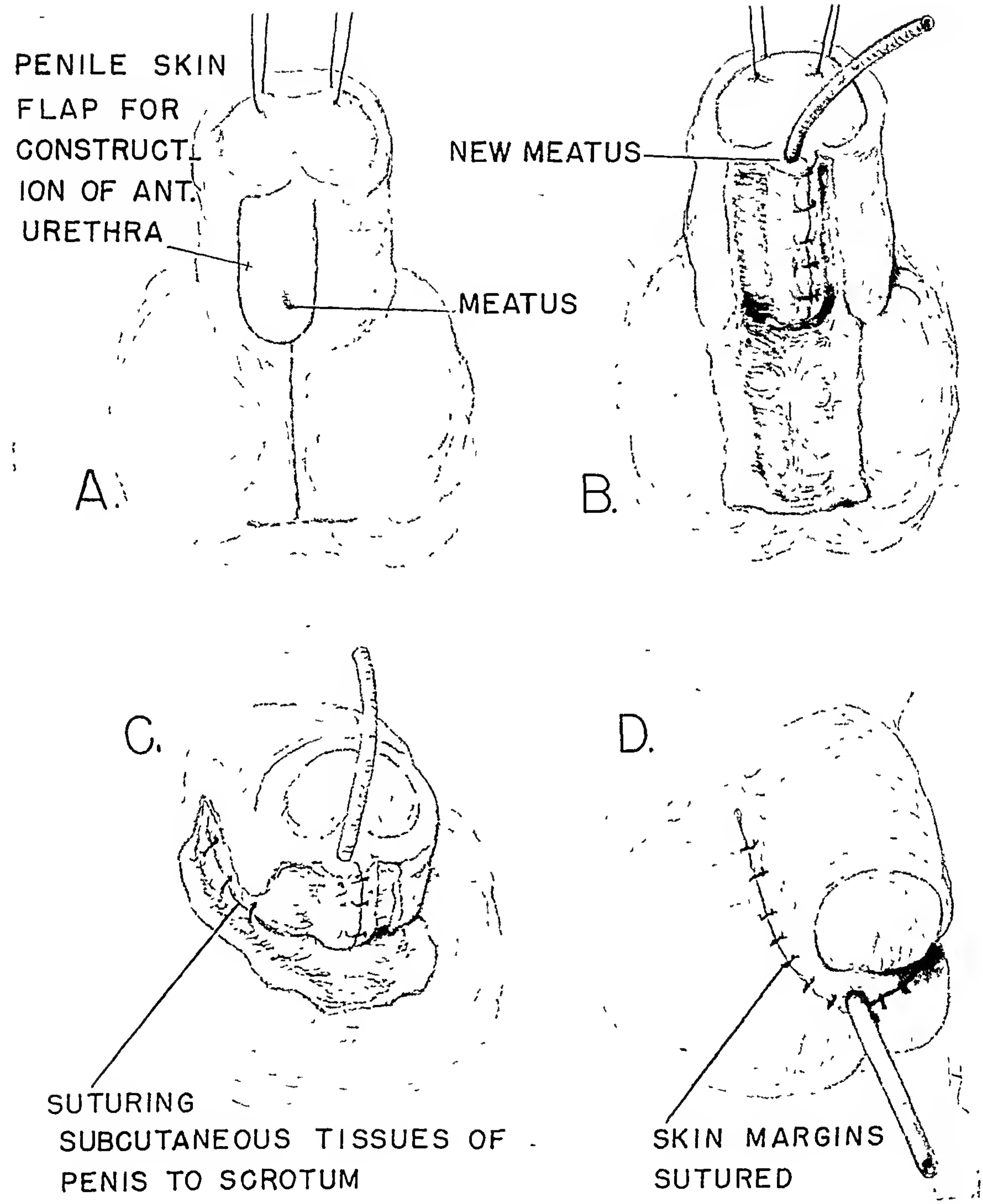


Fig 471 —Cecil's modification of the Bucknall operation The urethra is constructed from skin of the penis and buried in the scrotum

half of the flap is then carefully dissected up to the hypospadiac meatus As the dissection approaches the meatus a catheter may be inserted to avoid opening into the urethra The margins of the distal portion of the flap are then dissected up about a third of the distance to the midline, leaving a broad base to furnish blood supply (Fig 473B) The prepuce, which in the hypospadiac patient is deficient below, is grasped on each side and held up while an incision on each side beginning at the previous incision just above the corona is carried to the margin of the prepuce These incisions are joined by a horizontal incision which divides the mucous membrane of the prepuce just above the furrow of

Fig 474

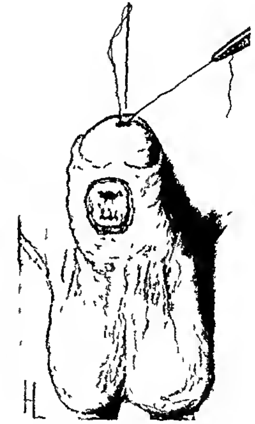


Fig 475

Fig 474—D M Davis method of closing urethral fistula following plastic operation for hypospadias The needle is passed through the meatus leaving one end of the thread The needle and thread are passed through the skin margin surrounding the fistula as illustrated
Fig 475—The needle is passed backed through the *meatus*

the glans The mucous membrane of the prepuce is then carefully dissected from the skin of the prepuce, care being taken to preserve the blood supply (Fig 473C) A broad flap is thereby formed to cover the skin defect on the ventral surface of the *penis*

The *purse* strings are now tightened and tied bringing the margins of the pouch together at the apex of the penis (Fig 473B and C) A Y shaped buttonhole *incision* is then made in the preputial flap (Fig 473D) The vertical arm of the Y begins at the level of the collar of the glans, and care is taken to

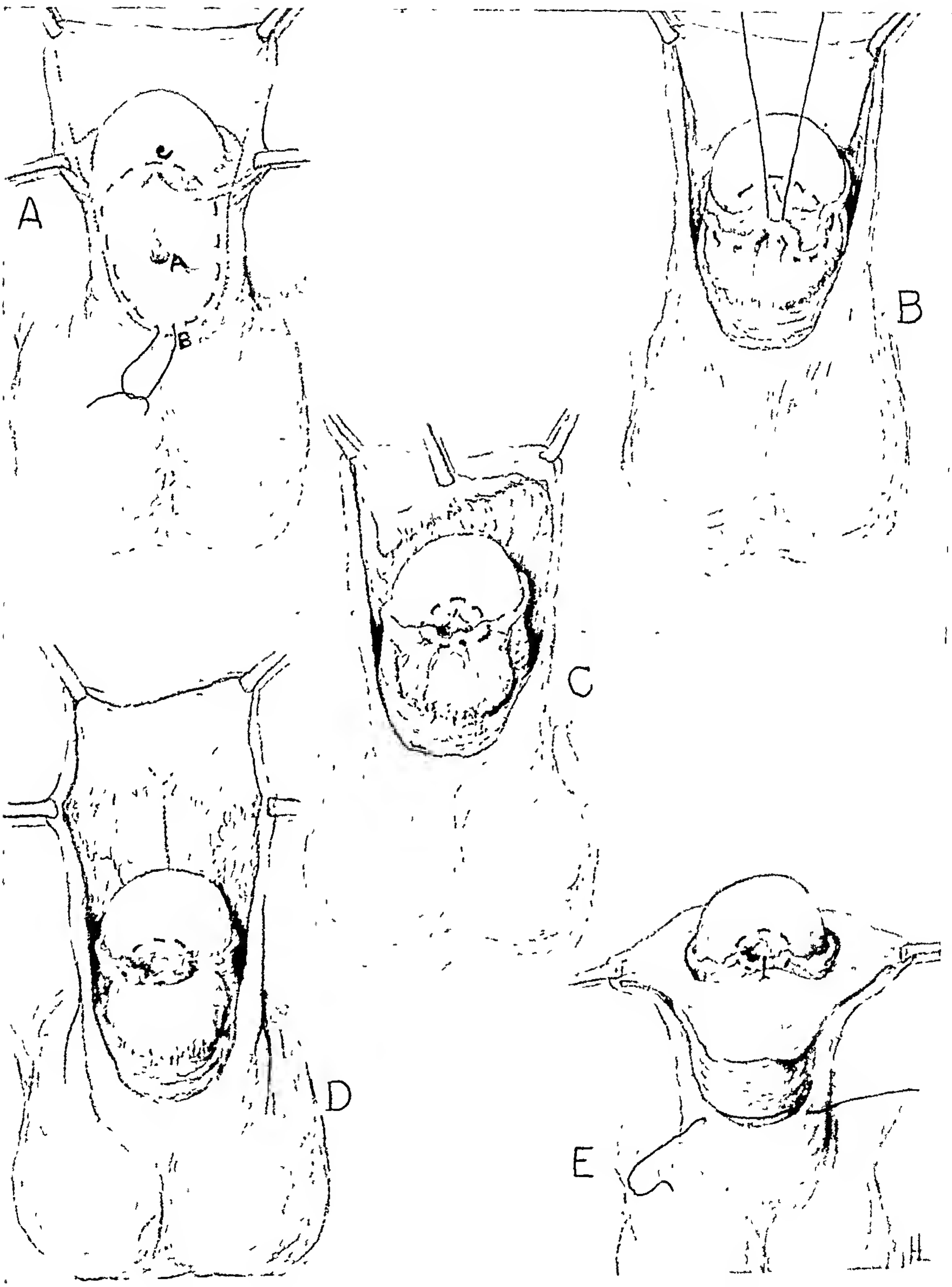


Fig. 473.—The Ombrédanne operation for the cure of hypospadias

half of the flap is then carefully dissected up to the hypospadiac meatus As the dissection approaches the meatus a catheter may be inserted to avoid opening into the urethra The margins of the distal portion of the flap are then dissected up about a third of the distance to the midline, leaving a broad base to furnish blood supply (Fig 473*B*) The prepuce, which in the hypospadiac patient is deficient below, is grasped on each side and held up while an incision on each side beginning at the previous incision just above the corona is carried to the margin of the prepuce These incisions are joined by a horizontal incision which divides the mucous membrane of the prepuce just above the furrow of

Fig 474

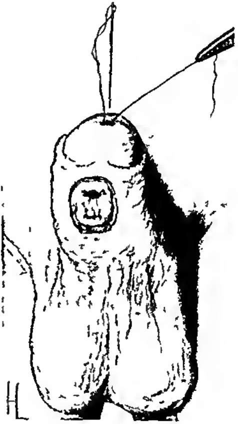


Fig 475

Fig 474 —D M Davis method of closing urethral fistula following plastic operation for hypospadias The needle is passed through the meatus leaving one end of the thread The needle and thread are passed through the skin margin surrounding the fistula as illustrated

Fig 475 —The needle is passed backed through the meatus

the glans The mucous membrane of the prepuce is then carefully dissected from the skin of the prepuce care being taken to preserve the blood supply (Fig 473*C*) A broad flap is thereby formed to cover the skin defect on the ventral surface of the penis

The purse strings are now tightened and tied bringing the margins of the pouch together at the apex of the penis (Fig 473*B* and *C*) A Y shaped buttonhole incision is then made in the preputial flap (Fig 473*D*) The vertical arm of the Y begins at the level of the collar of the glans, and care is taken to

avoid the blood vessels that course along the prepuce The glans penis is then brought through the Y incision The margins of the Y are sutured to the new urethral meatus and the edges of the preputial flap are sutured to the edges of the penile skin (Fig. 473*E*). If the flap does not cover the posterior portion of the wound, the skin edges in this area are readily approximated.

The penis should be gently stretched for four or five days so that the preputial flap becomes fixed. No dressings are required. The wound is gently washed after urination and a bland antiseptic dusting powder applied. In perineal hypospadias the operation is done in two stages, first converting the perineal hypospadias into a penile hypospadias and at the second operation, several months later, completing the urethra. When the operation is completed

Fig 476—The two ends of the suture are pulled upon, thus inverting the fistula The skin wound is closed over the fistula with subcuticular sutures of fine plain catgut The threads projecting from the meatus are kept under tension by fastening them to the abdomen with an intervening rubber band The bladder is drained through an external urethrotomy.

there is produced beneath the glans a redundancy which Ombrédanne called the "tubercle." About four months following the operation a more satisfactory meatus may be constructed by removing a strip of mucosa from each side of the glans, and a strip of tissue from each side of the tubercle. Then the meatus is formed by suturing the tubercle to the glans. At the time of this operation, hair-bearing areas of skin may be excised from the interior of the urethra

The Ombrédanne operation has the advantage that the urine does not have to be diverted and a cure is more certain than by any other method. There is the disadvantage that a portion of scrotal skin is used in most cases, with the growth of hairs and the possibility of urethral calculi. The urethra is pouch-

like and, therefore, does not approach the normals as is the case with the Thiersch and Duplay methods of urethral construction. I have only used the Ombredanne operation when the meatus was situated at or just behind the frenal area. Here the flap does not have to be quite so wide and a better cosmetic effect can be secured. The operation may be found useful when other methods have failed.

D. M. Davis has evolved the following method for closing small fistulas that remain after construction of a new urethra. An incision is made surrounding the fistula and the skin undermined. A straight needle threaded with silk is inserted eye first in the meatus and brought out through the fistula. One end of the thread remains protruding from the urethral meatus. The cut edges of the fistula are caught with the needle and thread. The needle and thread are then passed back through the meatus. When the two ends of the thread are pulled upon, the fistula is turned inside out, and made to project into the lumen of the urethra (Figs. 474, 475 and 476). The inversion of the fistula is maintained by fastening the threads to a rubber band which is attached to the skin of the abdomen under slight tension. By the time the thread pulls out, healing is almost complete. The subcutaneous tissues are brought together by interrupted sutures of fine plain catgut. An effort is made to pull one flap of skin over the fistula as far as possible. Subcuticular stitches are placed to draw the edges of the skin together. The Cecil operation (Fig. 471) is more satisfactory for large fistulas.

HERMAPHRODITISM

Individuals of double or doubtful sex often have anomalies of the external genitals and urethra which can be greatly benefited by appropriate plastic operations. This is illustrated by the following case history.

L. E., age 15, admitted to the hospital division of the Medical College of Virginia on October 28, 1940, because of maldevelopment of the external genitals. At birth the child was considered to be a girl and was so christened. At the age of two years she was brought to a Richmond hospital and the surgeon considered that there was a maldevelopment of external genitals, consisting of cryptorchidism, bifid scrotum, and hypospadias. The child was rechristened and the records in the registrar's office were changed. The surgeon advised that he return at the age of six for a plastic operation. Because of adverse financial conditions and the death of the surgeon the patient did not return to Richmond until the recent hospital admission.

Physical examination showed a well developed individual apparently two or three years older than his actual age with a fair growth of beard. There was a normal growth of axillary and pubic hair, the pubic hair resembling more the appearance of male than female. The external genitals consisted of a penis about four inches in length and bound down between the folds of a fairly normal appearing vulva although there were no labia minora (Fig. 477). The urethral opening was at the posterior portion of the vulva and the meatus admitted the tip of a Kelly forceps. There was no evidence of testicles (Fig. 478).

Fig 477—External genitals of pseudohermaphrodite. The patient has a small uterus and normal-appearing ovaries No testicles could be found Patient's inclinations and physical characteristics are those of a male

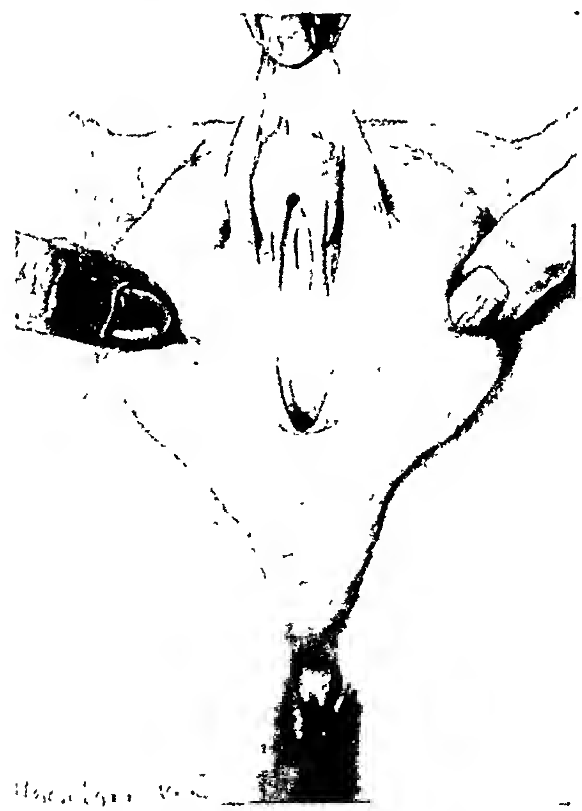


Fig 478—Ventral surface of the penis Urethral opening at lower portion of the vulva (See Fig 477.)

Fig 479—Internal genitals of case shown in Figs 477 and 478

Fig 480—External genitals (see Figs 477 and 478) following plastic operations for strengthening penis and constructing a urethra Vulval mucous membrane used for construction of urethra vulval skin dissected up and the margins sutured together forming a scrotum Testicles made from paraffin

Fig 477 —External genitals of pseudohermaphrodite The patient has a small uterus and normal-appearing ovaries No testicles could be found. Patient's inclinations and physical characteristics are those of a male

Fig 478 —Ventral surface of the penis. Urethral opening at lower portion of the vulva (See Fig 477.)

CHAPTER XXXIII

SURGICAL TREATMENT OF STRICTURES AND FISTULAS OF THE MALE URETHRA, AND PERINEAL DEFECTS

Meatotomy, Urethrotomy, External and Internal, Excision of Stricture, Urethral Anastomosis, Closure of Fistulas, Repair of Perineal Defects, Diverticula

MEATOTOMY

Meatotomy is often necessary for stenosis of the meatus and to permit instrumentation when the meatus will not admit a No 26 French instrument It is often advisable in the treatment of urethritis when the meatus is too small to permit adequate drainage

A cotton swab soaked in 5 per cent cocaine is inserted in the meatus for about two minutes A small amount of 1 per cent Novocain solution is then injected into the lower margin of the meatus The glans penis is held in one hand and the meatus is cut downward in the midline with a small knife The incision should be carried deep enough for the meatus to admit a No 28 French instrument easily The bleeding is controlled by constant pressure for about five minutes To facilitate healing and prevent contraction, it is advisable to place a small absorbable suture on each side, approximating the mucous membrane of the urethra to that of the glans

INTERNAL URETHROTOMY

Internal urethrotomy is used in very dense strictures of the anterior urethra which do not yield to dilatation with sounds The stricture must be of sufficient caliber to admit a small instrument With the bladder partially distended with fluid and the urethra having been irrigated, a filiform is passed and screwed onto the urethrotome The staff of the instrument is passed gently through the urethra until the tip rests within the prostatic urethra The penis is drawn out until the anterior urethra is under considerable tension The obturator carrying a guarded knife is then passed along the grooved staff until the stricture is reached When resistance indicates the presence of the stricture the operator forces the blade through the stricture The release of the obstruction will indicate that the stricture has been divided The knife may then be gently passed through the remainder of the anterior urethra dividing any other strictures that may be encountered The knife should not be carried beyond the bulbous urethra, as incision into the membranous urethra may cause considerable bleeding The cut should be made on the roof of the urethra and should not be repeated except in very dense strictures when a small blade may be passed first, to be followed by a larger blade which is inserted in the same

At operation the day following admission no evidence of an inguinal canal could be found The abdominal cavity was opened and a fairly normal uterus, ovaries and tubes were located in the normal position (Fig. 479). Sections from the ovaries showed numerous atresic follicles and few primordial follicles. There were also several follicular cysts. On careful search no testicles were found. The wound was closed and adhesions binding the penis downward were liberated.

June 24, 1942, he returned to the hospital and a urethra was constructed to the base of the glans by the method of Thiersch (Figs. 453-458). The operation was successful with the exception of a small fistula near the base of the penis. On Aug. 13, 1942, this fistula was closed and the urethra brought through the glans by freeing small skin flaps from the lateral surfaces of the penis with their bases at the urethral orifice and drawing them through a stab wound which pierced the glans from base to apex near the ventral surface.

After completing the plastic operation on the penis a testicular prosthesis was carried out by placing small rounded masses of paraffin in the scrotum which had been constructed at the previous operation by suturing the labia over the posterior portion of the newly constructed urethra (Fig. 480).

Before undertaking these operations, the patient was studied by a psychiatrist who found that his attitude and physical characteristics were preponderately male regardless of the presence of internal female genitals

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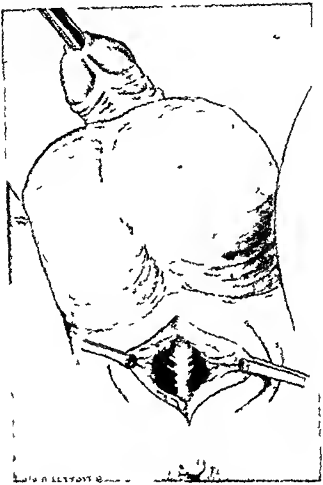


Fig 481 —Incision for exposure of stricture in bulbous or bulbomembranous portion of urethra

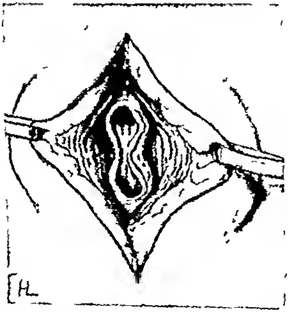


Fig 482 —The strictured area has been exposed and scar tissue dissected away

incision. The instrument is then removed, leaving the filiform in place. The filiform is screwed on a sound or dilator which is used to dilate the urethra to the desired caliber. Successive sizes may be used up to 28 or 30 French.

Following the dilatation a large urethral catheter should be passed and the bladder thoroughly irrigated with an antiseptic solution. If there is much bleeding, the catheter is tied in the urethra and a pressure bandage is placed around the penis. Following the operation it is necessary to pass sounds at first once a week and later at gradually increasing intervals to prevent recurrence of the stricture.

Most strictures will respond to gentle dilatation without urethrotomy.

EXTERNAL URETHROTOMY AND URETHROSTOMY

External urethrostomy is done for simple drainage of the bladder when it is desirable to put the anterior urethra at rest, to prevent contamination of plastic operations on the urethra, and for the treatment of deep and impassable strictures. The urethra is opened in the anterior part of the bulbous urethra. The operator presses on each side of a sound with the fingers and makes an incision from one to two inches (2.5 to 5 cm.) in length directly over the sound and in the midline of the perineum. The tissues are divided, to the sound (Fig. 450). Bleeding points are clamped and ligated and the mucous membrane is caught with sharp tooth forceps or sutures and the sound is withdrawn. The operator may then pass instruments for the dilatation or incision of the stricture or introduce a catheter for drainage. If drainage is being instituted preparatory to a plastic operation on the urethra, it is well to pass a ligature of heavy silk or silkworm-gut around the urethra just external to the urethrotomy and tie it just tightly enough to occlude but not to cut through the urethra (Fig. 450). By this precaution urine that may be forced around the catheter cannot pass into the anterior urethra.

If a sound cannot be passed to the bulbous urethra because of stricture in the pendulous urethra, the urethra is exposed by careful dissection through the median raphe of the perineum, recognizing and dividing Colles' fascia, the bulbocavernosus muscle, the corpora spongiosum and finally the urethra. Bleeding must be controlled as the dissection progresses so that the individual structures can be recognized. If the anatomy is so distorted by scar tissue that the urethra cannot be recognized, a urethrotomy may be done in the membranous urethra as described on page 615.

PERINEAL OPERATIONS FOR STRICTURE OF THE URETHRA

Most strictures that require exposure through the perineum are located in the bulbous or membranous urethra. They vary considerably in extent and multiplicity and may be complicated by inflammation, abscesses or fistulas; consequently the surgical requirements vary to some extent with each case. When strictures are accompanied by acute inflammation or abscesses the bladder should be drained by suprapubic or perineal incision without disturbing the stricture. Diversion of the urine and drainage of the inflamed periurethral tissues will relieve the congestion of the strictured area to the extent that dilata-

strictured area and serves as a guide for the incision into the urethra (see urethrotomy) As the incision is made through the skin, fascia and muscles overlying the urethra, spurting vessels are clamped and tied so that a clear view of the urethra will not be obscured by blood (Fig 481) The urethra is opened on the sound and the mucous membrane is caught with small hemostats The point of a small knife is carefully forced through the stricture, using the posterior surface of the sound as a guide It is well to dissect away as much of the scar tissue as possible, taking care to preserve a strip of mucous membrane through the strictured area (Fig 482) A large catheter is then inserted through the meatus and into the bladder (Fig 483) The cavernous and muscle tissues of

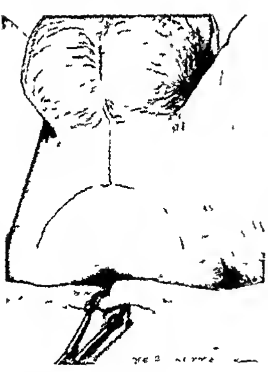


Fig 485

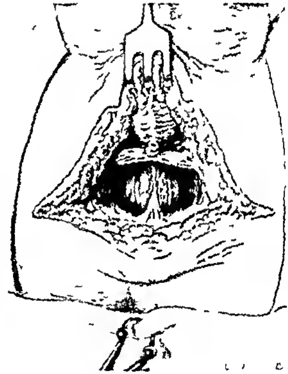


Fig 486

Fig 485.—Incision for operation without a guide upon stricture of the urethra
Fig 486.—Superficial fascia and central tendon are divided exposing bulbocavernosus levator ani and transversus perinei muscles

the bulbous urethra are then drawn snugly together over the catheter by interrupted sutures of plain catgut (Fig 484 A) The perineal fascia is closed with catgut and the skin and superficial fascia are united with interrupted sutures of silk or cotton except at the lower angle of the wound where a small drain is inserted (Fig 484B) The catheter is fastened in the urethra and retained for about ten days The urethral mucous membrane covers a defect very rapidly and extensive plastic operations for the relief of stricture are rarely indicated

tion with filiforms and sounds can often be accomplished without the necessity of cutting the stricture. When operation is necessary it can be done more accurately and the final results are more satisfactory when the inflammation is permitted to subside before the cure of the stricture is attempted.

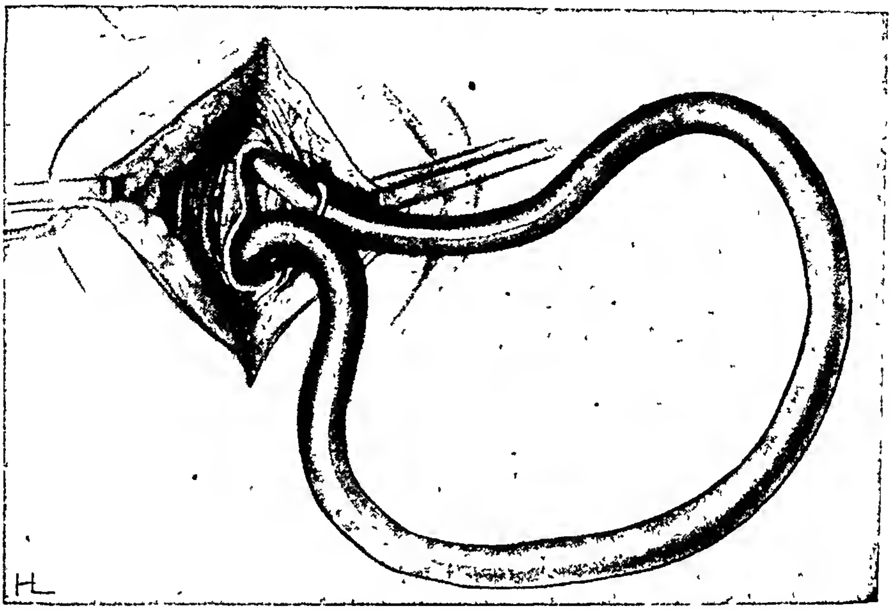
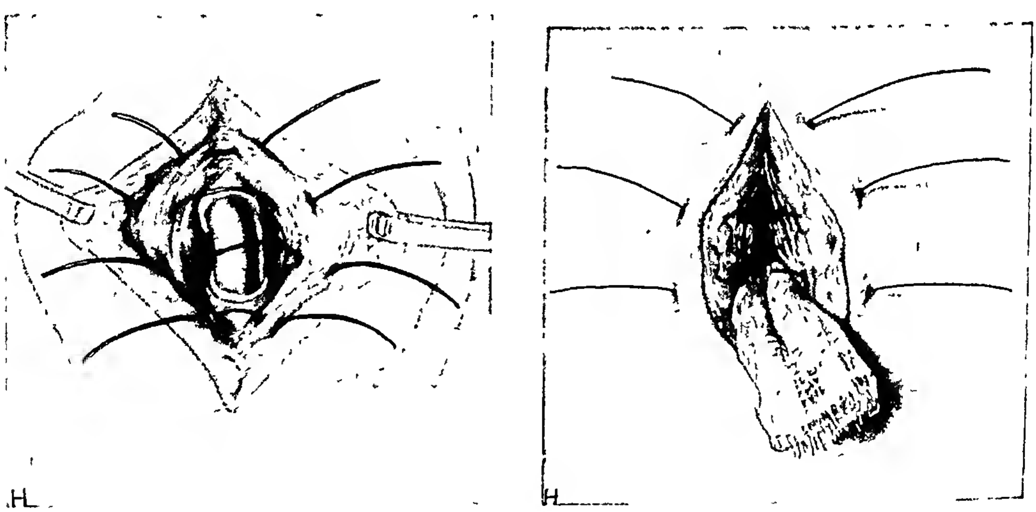


Fig 483—A rubber catheter is placed for drainage of the bladder and to ensure an adequate channel in the strictured area If it is difficult to pass the catheter from the meatus, the tip may be passed into the bladder through the urethrotomy and the free end fitted over the tip of a sound in the urethra which, when withdrawn, leaves the catheter in place



A B

Fig 484—*A*, With the catheter in place, the muscles and fascia are loosely sutured over the urethra with interrupted sutures of No 1 chromic catgut *B*, The skin is closed with interrupted sutures of silkworm-gut or Zytor with a small drain in the lower angle

Operations for the cure of stricture are much more successful when a careful dissection is carried out, recognizing and preserving as nearly as possible the structures of the perineum and removing scar tissue. If a filiform can be passed it is screwed on to a small sound which follows the filiform through the

If the opening in the stricture cannot be located, prolonged blind dissection is unwarranted and may cause considerable damage to the perineal structures. It is preferable to locate the urethra and the proximal extent of the stricture by retrograde passage of sounds, either suprapubically or through the perineum.

If the suprapubic route is chosen the bladder is opened through a small suprapubic incision and a sound, preferably with a Guyon curve, is introduced through the prostatic urethra until its beak presents just behind the stricture. The urethra is opened over the point of the sound and its margin secured with small hemostats or sutures. The stricture intervening between the healthy portions of the urethra is divided and the scar tissue dissected away. Often when the lumen of the urethra is opened behind the stricture a filiform or probe can be introduced into the stricture retrograde, greatly facilitating division of the stricture. If the stricture is short, only two or three centimeters long and surrounded by dense scar tissue it may be excised entirely and the healthy ends of the urethra mobilized for a short distance and sutured together, making an end to end anastomosis. It is only necessary to unite the walls of the urethra at the roof to ensure a good result.

If the perineal route is selected the operation is carried out as described by H. H. Young. An inverted U incision is made at the lower angle of the perineal incision (Fig. 485) and the membranous urethra and apex of the prostate are exposed as in perineal prostatectomy (Fig. 486). When the apex of the prostate is reached a small incision is made in the proximal portion of the membranous urethra (Fig. 487) and the tip of a sound inserted and passed back to the stricture (Fig. 488). This is made easier by dilatation of the urethra that always occurs behind a stricture. The urethra is then incised over the tip of the sound and the operation continued as described following the suprapubic passage of a sound.

EXCISION OF STRICTURE WITH URETHRAL ANASTOMOSIS

Granville MacGowan devised an operation for excising the strictured area and making an end to end anastomosis of the healthy ends of the urethra. With the patient in an exaggerated lithotomy position, an inverted Y shaped incision is made in the perineum. The two limbs of the Y extend toward the ischial tuberosities on each side of the anus and the stem of the Y is carried forward over the corpus spongiosum as far as necessary to expose the strictured area and free the healthy urethra sufficiently to close the defect after the resection. After the skin and superficial perineal fascia have been divided, the triangular flap is retracted downward, exposing the central tendon and the muscles overlying the proximal portion of the bulbous urethra. The central tendon is divided close to the bulb exposing the anterior layer of the triangular ligament. After pushing the ischiocavernosus muscles aside the bulbocavernosus tendon is split along its center to its point of junction with the tendons of the superficial transverse perineal muscles at the root of the bulb. These tendons are clamped and

When it is impossible to introduce a filiform or small sound through the urethra, division of the stricture is more difficult. It is helpful to inject the urethra with a 1 per cent aqueous solution of methylene blue. The dye should be injected into the urethra with some force and milked back so that a portion will permeate the stricture. The urethra anterior to the stricture is then irrigated to prevent staining the wound A sound is passed down to the point of obstruction which is usually in the bulbous urethra or at the bulbomembranous

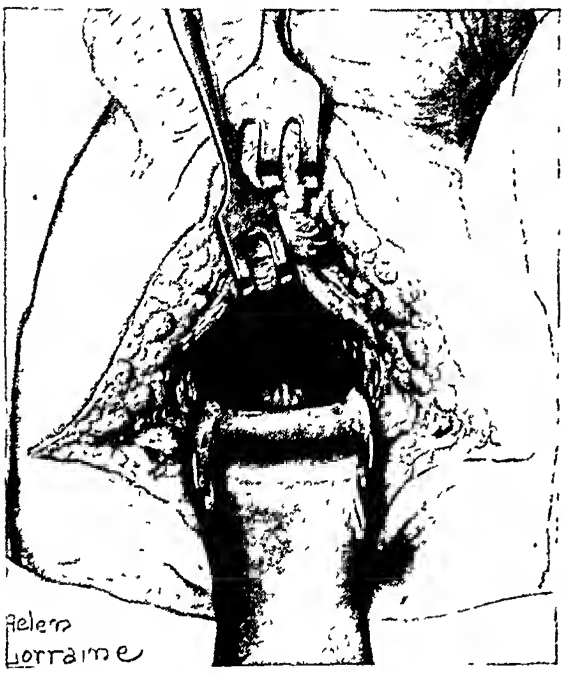


Fig 487

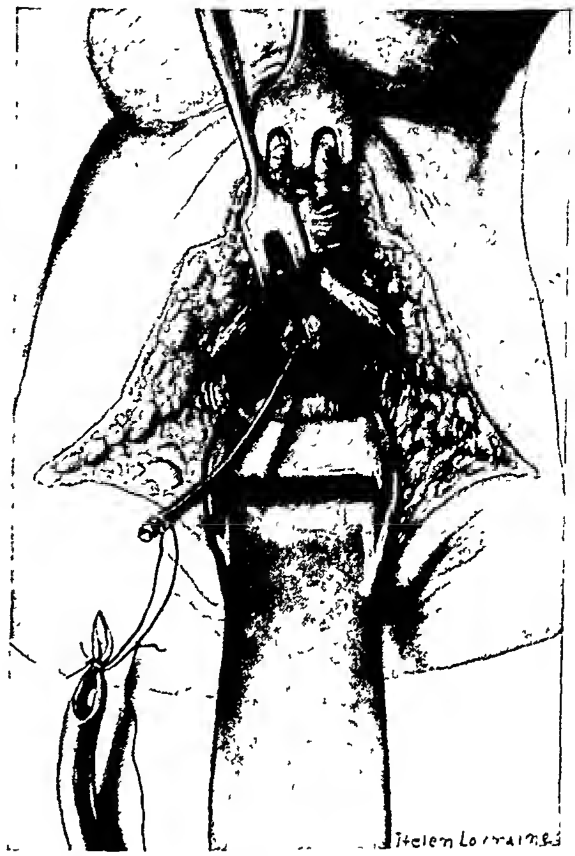


Fig. 488

Fig 487 —Transversus perinei muscles are retracted forward and membranous urethra is exposed by separating the median fibers of the levator ani muscles An external urethrotomy is done

Fig. 488.—A filiform bougie is passed retrograde and emerges at the urethral meatus The end of a catheter is cut on the bias, tied to the filiform, and drawn through the anterior urethra The tip of the catheter is then inserted through the urethrotomy wound into the bladder, and the wound is closed with a small rubber tissue drain, leaving an indwelling catheter for dilatation of the stricture and drainage of the bladder. If the stricture is extremely dense or there is surrounding scar tissue, the incision may be extended further forward, the scar tissue dissected away, and the stricture divided. (See Fig 482)

area. The incision is carefully carried down to the tip of the sound, the bleeding is controlled, and the urethra is incised as far as the obstruction. Usually a view of the stricture stained with the dye can be obtained and a probe or a bougie accurately introduced through the stricture. The stricture is then divided by a small knife on the probe or bougie. The scar tissue is dissected away and a catheter inserted. The wound is closed as previously described.

If the opening in the stricture cannot be located, prolonged blind dissection is unwarranted and may cause considerable damage to the perineal structures. It is preferable to locate the urethra and the proximal extent of the stricture by retrograde passage of sounds, either suprapubically or through the perineum.

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divided close to their insertion into the spongy body, exposing the urethra which, by gentle blunt dissection using gauze and the knife handle, is freed from its muscular coverings and its attachment to the cavernous bodies as far backward and forward as necessary to expose the strictured area and healthy mucosa upon opening the canal both behind and in front of the stricture. The strictured area is recognized and excised Methods of identifying and localizing the stricture are similar to those previously described in this chapter. The ends of healthy urethra are mobilized, split into three strips, one posterior, or at the roof, and two lateral An end-to-end anastomosis is made, suturing each strip of urethra of one segment to the corresponding strip of the other. The urethra must be sufficiently mobilized so that there will be no tension on the sutures. MacGowan advised the excision of as much as 8 or 9 cm. when necessary, which requires rather extensive separation of the urethra and corpus spongiosum from the corpora cavernosa to effect a satisfactory closure. This is possible because of the liberal blood supply and the elasticity of tissues in this area. When the anastomosis is complete a catheter is placed through the urethra for splinting and bladder drainage, the perineal structures are accurately approximated with fine chromic catgut sutures, and the wound is closed with adequate drainage.

Somewhat similar methods of treating strictures have previously been described by Albarran, Marion and by Hamilton Russell of Melbourne. Cabot and Stearns have devised methods of dividing the stricture on the floor of the urethra and suturing the urethral incision in the opposite direction, thereby enlarging the lumen in that area. None of these operations has a very wide application The urethral mucous membrane will cover a defect very rapidly and if a strip of healthy mucosa can be left, excessive scar tissue excised, and healthy perineal tissue closed over the defect bridged by an indwelling catheter, a satisfactory urethral lumen may be expected in most cases Occasionally a patient is encountered with healthy urethral segments separated by an intervening area of dense scar tissue, usually resulting from injury. In such cases excision of the mass of scar and end-to-end anastomosis is the most satisfactory method of treatment.

EXCISION OF PERINEAL FISTULAS

Strictures of long standing are frequently complicated by perineal fistulas. These are caused by a previous perineal abscess or follow injuries or operations. They are usually surrounded by masses of scar tissue and rarely heal permanently even when the stricture is adequately dilated. They may be single or multiple and may open in the scrotum, perineum, buttocks or ischiorectal passage. When possible the stricture should be well dilated before fistulas are excised and when there is abscess or acute inflammation the inflamed tissue should be given adequate drainage by incision or dilation of the fistulous tracts and the application of heat and antiseptic irrigations until all evidence of acute inflammation has subsided. Usually there will remain a considerable mass of thickened tissue surrounding the fistulous tracts This chronic inflammatory tissue with the fistulous tracts must be dissected down to the urethra when prac-

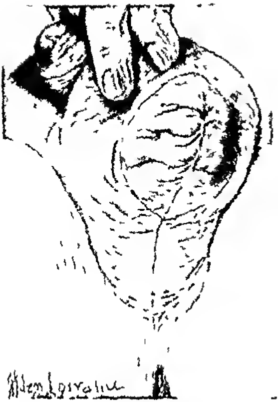


Fig. 489

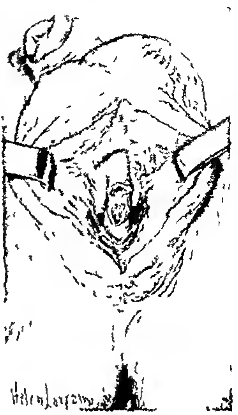


Fig. 490

Fig. 489.—Incision for excision of urethral fistulas and chronic inflammatory tissue complicating urethral stricture.

Fig. 490.—Fistulous tracts and inflammatory tissue (Fig. 489) have been dissected away and the stricture is divided. A urethral catheter is now inserted for urethral splint and bladder drainage and the wound is closed with a small rubber tissue drain in the lower angle.

Fig. 491.—Postoperative result following excision of fistulous tracts and dividing stricture.

tical. If complete excision involves important structures such as the external sphincter the excision should be carried as far as possible and the remainder of the fistulous tract thoroughly curetted.

At the beginning of the operation, after cleansing the perineum and external genitals and irrigating the urethra, the fistula or fistulas should be injected with a 1 per cent aqueous solution of methylene blue to outline the tract. If it is difficult to inject the fistula from the skin surface, the forceful instillation of the solution through the urethra, at the same time making pressure against the urethra at the bulbomembranous area to prevent the solution from entering the bladder, will force it out through the fistula, clearly outlining its various ramifications. This having been done, elliptical incisions are made surrounding the fistulous opening or openings and the dissection is carefully deepened toward the urethra, keeping as nearly as possible in healthy tissue and including in the mass to be excised all the dense scar tissue surrounding the fistula (Fig. 489). If there is a large mass of superficial scar tissue such as is encountered when the scrotum is involved, it becomes rather cumbersome as the urethra is approached. If the mass interferes with accurate dissection, it should be excised and the fistula identified by the blue stain and followed to the urethra. The tract is usually surrounded by well-organized scar tissue and can easily be dissected from the surrounding healthy tissue When there are several openings on the surface they usually merge into one tract before entering the urethra. This opening into the urethra is situated in most cases just behind the urethral stricture. If the stricture has not been adequately dilated the opening in the urethra caused by excising the fistula may be extended forward and the stricture divided (Fig. 490). When the fistula has been excised and bleeding controlled, a catheter is fixed in the urethra for drainage of the bladder and the healthy tissue is closed over the defect with interrupted sutures of 0 plain catgut. Adequate drainage is provided by rubber tissue and the skin is closed with interrupted nonabsorbable sutures (Fig 491).

CLOSURE OF RECTOURETHRAL FISTULA

Rectourethral fistula may be the result of inflammation or traumatism. Traumatic cases usually follow operations upon the prostate. Although the rectum is more frequently injured during perineal prostatectomy, rectourethral fistula may occur after suprapubic or retropubic prostatectomy. If the injury to the rectum is recognized at the time of operation, the wound in the rectum should be repaired immediately and the bladder drained suprapubically Young advised that if the rectal injury is recognized before the prostate has been removed, the operation should be discontinued. If the patient is in good condition after the rectal injury has been repaired and the perineal wound closed, the prostate may be removed suprapubically at the same time. In most cases it is wise to be content with suprapubic drainage and remove the prostate at a second operation.

When the rectal injury is not recognized at the time of operation or when the rectal wall sloughs because of pressure from packing, the first indication of injury is the appearance of gas or fecal matter from the perineal wound. When

this occurs suprapubic cystostomy should be done immediately and the rectal sphincter widely dilated. Immediate diversion of the urine will often permit the fistula to close.

The fistula may be closed by operating through the rectum by a method similar to that of closing a vesicovaginal fistula. Spinal anesthesia should be used when possible because of the excellent relaxation of the anal sphincter. The intestinal tract should be prepared by a low residue diet and antibiotics several days before operation and purgation the day before operation.

After a suprapubic cystostomy is done for drainage the patient is placed in the Sims position with the head lowered, the perineum is thoroughly cleansed, and a retractor is placed in the posterior portion of the rectum. Traction on this retractor permits an excellent view of the anterior wall of the rectum and the fistulous opening is readily identified. The rectum is then cleansed with a mild antiseptic solution and thoroughly dried.

Longitudinal elliptical incisions are made surrounding the fistula. The fistulous tract is then carefully dissected out to the urethra. The dissection should keep close to the tract. When the urethra is reached the fistula is excised with a narrow margin of healthy urethral wall. When the fistula has been excised the urethra and rectal wall will be found to have separated by a distance considerably greater than the length of the fistulous tract. The opening in the urethra is easily recognized in the depth of the wound. It is closed with interrupted sutures of fine chromic catgut. The walls of the dissected tract between the rectum and urethra are now approximated by interrupted sutures, preferably of fine kangaroo tendon. The submucous layer of the rectum is carefully approximated by interrupted sutures of 0 chromic catgut. No sutures are placed in the mucosa. This simple procedure has been effective in the three cases in which I have used it.

YOUNG'S OPERATION

The operation employed by H. H. Young in the treatment of rectourethral fistulas is a modification of the operation he originally devised in cooperation with Harvey Stone. The most important feature of this operation is the utilization of the Whitehead principle of freeing the mucosa and submucosa of the rectum and pulling it down so that the diseased portion of the rectal wall can be excised and a healthy surface of the rectum is presented against the urethral fistula.

After suprapubic drainage has been provided the patient is placed in the exaggerated lithotomy position, preferably on a table designed for perineal operations. The rectal sphincter is dilated and the perineum and rectum are thoroughly cleansed. A racket shaped incision is made starting in the midline of the perineum about two inches in front of the anus and encircling the anus at the mucocutaneous juncture. Scar tissue is carefully dissected from the perineum back to the prostatic urethra. The rectal sphincter is carefully preserved. The rectal mucosa and submucosa are liberated from the sphincter and rectal muscles in the same way that it is done in the Whitehead operation

for hemorrhoids Because of adhesions in front of the rectum it is usually more satisfactory to separate the lateral and posterior walls of the rectum as far upward as possible before extending the dissection to the anterior wall. Hemorrhoidal clamps may be used in making traction on the cuff of bowel to pull it down as it is separated When the submucosa has been dissected from the sphincter anteriorly the sphincter is retracted forward and the rectum separated anteriorly to the fistula. The fistulous tract is excised and the dissection carried about an inch further upward so that there is a healthy cuff of bowel of sufficient length to extend to the cutaneous margin. The deeper portion of the dissection is facilitated by inserting a prostatic tractor either through the urethra, using a urethral model, or through the fistulous tract, to pull the deeper tissues downward and make them more accessible When the rectal cuff has been liberated well beyond the fistula and the fistulous tract divided, the fistulous tract is dissected out including a narrow margin of urethral mucosa The urethral opening is then closed with interrupted sutures of chromic catgut and the prostatic tissues and muscles are closed over the urethra with similar sutures, making a bulky mass of tissue between the urethra and rectum

If the rectal sphincter has been damaged it is carefully repaired. The cuff of rectal mucosa and submucosa is pulled down until the fistulous area presents beyond the cutaneous margin. Four sutures of chromic catgut are taken to secure the rectal wall to the subcutaneous tissue external to the sphincter The protruding cuff is then excised including the fistulous opening. The rectal mucosa is carefully approximated to the skin with interrupted sutures of fine chromic catgut. A small rubber drain is placed in the depths of the perineal wound. The subcutaneous tissues are approximated with interrupted sutures of No. 1 plain catgut and the skin is closed with coarse nonabsorbable sutures

Aftercare.—It is important to maintain good suprapubic drainage The suprapubic tube should be irrigated sufficiently often to be sure it remains open. Only gravity irrigation under low pressure should be used and sufficient fluid should not be run in to cause a desire to void. A low-residue diet is given and lead and opium pills, to tie up the bowels for a week Before giving a purgative the fecal mass should be softened by the administration of large doses of mineral oil twice a day for two or three days

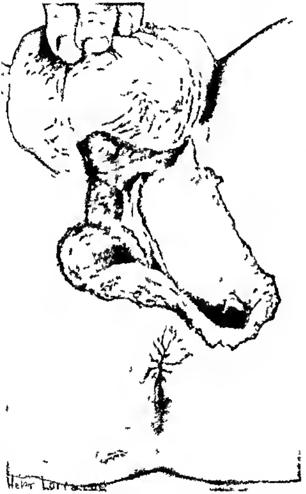
The drainage tube is removed in two or three days and the surface wound kept clean by applications of a mild antiseptic.

REPAIR OF PERINEAL DEFECTS

When the perineal tissue overlying and supporting the urethra is destroyed by disease or injury the problem of the successful repair of urethral defects is much more difficult (Fig. 492). The most frequent cause of destruction of the superficial perineal tissue is periurethral abscess or phlegmon. Occasionally a portion of the urethra sloughs away and restoration of the channel is impossible without the support of healthy skin and fascia. This may be obtained by turning in skin flaps from the thighs, but if the scrotum has not been destroyed with the skin and fascia of the perineum, it is an excellent source from which to obtain tissue to repair the defect. There is considerably more scrotum than is

needed for its function The posterior portion of the scrotum can easily be shifted to the perineum It has an abundant blood supply which need not be interfered with and the texture of the scrotal skin is but slightly different from that of the perineum

The following operation was done on a patient who had lost the superficial tissue of the perineum from the base of the scrotum almost to the anus and the floor of the bulbous urethra because of extensive periurethral suppuration



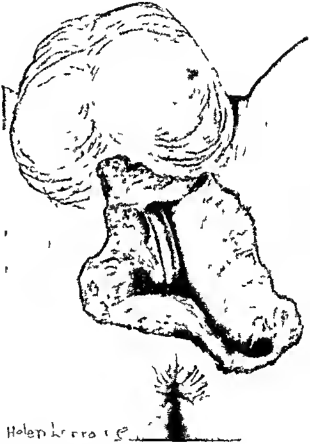


Fig 492 —Extensive perineal defect involving the bulbous urethra following stricture of the urethra and periurethral abscess (Dodson Transactions American Association of Genito Urinary Surgeons 33 211 –0 1940)

Fig 493 —Repair of perineal defect An indwelling catheter is in place Dotted line indicates portion of scrotum to be used to repair the defect (Dodson Transactions American Association of Genito Urinary Surgeons 33 11 – 0 1940)

A curved incision was made which began at the junction of the left margin of the scrotum with the perineal wound and passed upward and across the scrotum dividing it in half The incision then ran toward the base of the scrotum on the right side for a short distance, leaving a pedicle between the end of the incision and the perineal wound on the right side (Fig 493) The incision was carried through the entire thickness of the scrotum to the tunica

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vaginalis This scrotal flap was dissected free and rotated to the left and downward over the urethral defect No effort was made to cover the entire denuded area The flap was sutured in place with silkworm gut sutures For a short distance on both sides the margin of the flap was sutured to the skin margin

Fig 496 —Condition of the wound thirty days following repair of perineal defect with skin flap from scrotum (Dodson Transactions American Association of Genito Urinary Surgeons 33 211 220 1940)

Fig 497

Fig 498

Fig 497 —Result following repair of perineal defect with transplantation of flap from scrotum

Fig 498 —Evidence of satisfactory urethral function one month after operation (Dodson Transactions American Association of Genito Urinary Surgeons 33 211 220 1940)

of the perineal wound The remainder of the flap was anchored to the surface of the wound by deep sutures passing through the flap and as much of the underlying tissue as could be grasped (Fig 494) The remaining portion of the scrotum was closed over the testicles by a continuous suture of No 0 chromic

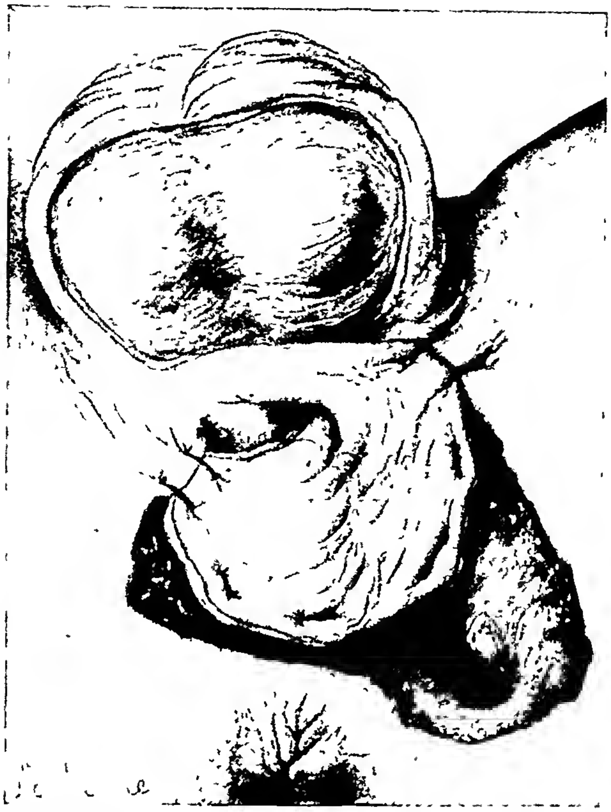

Fig. 494—Skin flap from the scrotum is sutured in place over the defeet. (Dodson Transactions American Association of Genito-Urinary Surgeons, 33 211-220, 1940.)

Fig 495—Wound in the scrotum is closed completing the operation (Dodson Transactions American Association of Genito-Urinary Surgeons, 33 211-220, 1940)

over the bulging portion of the diverticulum which is made prominent by the distention with the 30 cc bag of a Foley catheter This is a very helpful procedure if the neck of the diverticulum is sufficiently wide to engage the catheter bag The incision is carried through the skin, subcutaneous fascia and Buck's fascia, each layer in turn being stripped from the diverticulum, which is freed in all directions down to its connection with the urethra The diverticular wall consisting of the tunica albuginea, corpus spongiosum, and mucous membrane is then excised, trimming off each side down to the approximately normal urethral lumen The mucosa is closed over a No 24 F urethral catheter with interrupted sutures of 0000 chromic catgut on an atraumatic

Fig 499 —Diverticulum of anterior urethra—preoperative urogram

needle, avoiding penetration of the mucosa striving to invert the edges The more superficial layers are then trimmed accordingly before closing so as to afford adequate support where tissues were stretched by the diverticulum Cotton or catgut sutures or a combination of either of these with stainless steel wire are satisfactory In the presence of considerable vascular oozing from extensive dissection a small rubber tissue drain is placed over the closed mucous membrane layer and removed in 24 to 48 hours An indwelling 16 F catheter is stitched to the prepuce and acts only as a splint in those cases which have had shunting of their urinary stream This catheter should be removed

catgut (Fig. 495). At the beginning of the operation a urethral catheter was passed through the anterior urethra and into the bladder for drainage and to serve as a scaffold for the formation of a new urethra in the perineal area (Fig 493) The catheter was sutured to the glans penis with silkworm gut and fastened to the penis with strips of adhesive tape A firm perineal dressing was applied.

The entire graft remained in good condition and healing progressed satisfactorily (Fig 496). Two weeks after the operation the patient persuaded an interne to remove the suture retaining the catheter to the glans penis He then promptly pulled the catheter out, and in a short time voided satisfactorily but with some perineal leakage A catheter was reinserted with very little difficulty and kept in place ten days. At this time a No 24 F sound could be passed and voiding was satisfactory (Figs. 497 and 498).

DIVERTICULA

Urethral diverticula in the male are less common than in the female. Of 146 reported in the literature to date, 82 were in the anterior urethra and 64 in the posterior urethra. Most of those in the anterior urethra have been classified as congenital, while most of the posterior urethral diverticula are said to be acquired.

LeComte and Herschman have modified Watt's classification and have listed urethral diverticula by their location and origin In the anterior urethra, congenital diverticula are the result of a primary defect or the rupture of a primary cyst. Acquired diverticula in this portion develop subsequent to obstruction (stricture, stone), inflammation (rupture of abscess), or injury to the urethral wall (perforating or nonperforating)

In the posterior urethra congenital diverticula occur on the same basis as in the anterior urethra. Acquired diverticula of the posterior urethra result from obstruction, prostatic calculi, inflammation, or injury.

Diverticula of either the anterior or posterior urethra may be caused by rupture of an abscess or a cyst of Cowper's gland.

The finding of a mass is a prominent objective and subjective symptom. Urine or purulent fluid may be expressed manually from the mass after the act of micturition. Urinary symptoms are usually present and consist of frequency, dysuria, pyuria, terminal incontinence, and at times complete obstruction with acute retention. A persistent urethral discharge may be the presenting symptom. At times, bizarre sexual symptoms or infertility may be the chief complaint. Upper urinary tract changes may be present because of infection or obstruction. The final diagnosis is established by urethrography (Fig. 499) and urethroscopic examination.

The treatment of choice is excision of the diverticulum with plastic repair. The urinary stream should be diverted prior to repair, as most diverticula are badly infected. This is accomplished by suprapubic cystostomy or perineal urethrostomy as indicated by the location of the diverticulum. Surgical procedure in diverticula of the anterior urethra consists of a longitudinal incision

within 72 hours Following healing of the wound and the re establishment of the normal urinary passage, sounds should be passed to prevent postoperative stricture (Fig 500)

When the diverticulum is of the posterior urethra more adequate exposure can be obtained by making an inverted "U" incision in the perineum similar to that used for exposure of the prostate (Fig 501, A) The diverticulum is freed by sharp and blunt dissection to the urethra where it is excised and the urethra closed as previously described (Fig 501, B) The levator muscles are then closed over the urethra by interrupted sutures of chromic catgut (Fig 501, C), and the skin and superficial fascia with coarse silk

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Fig 500 —Diverticulum of anterior urethra—postoperative urogram

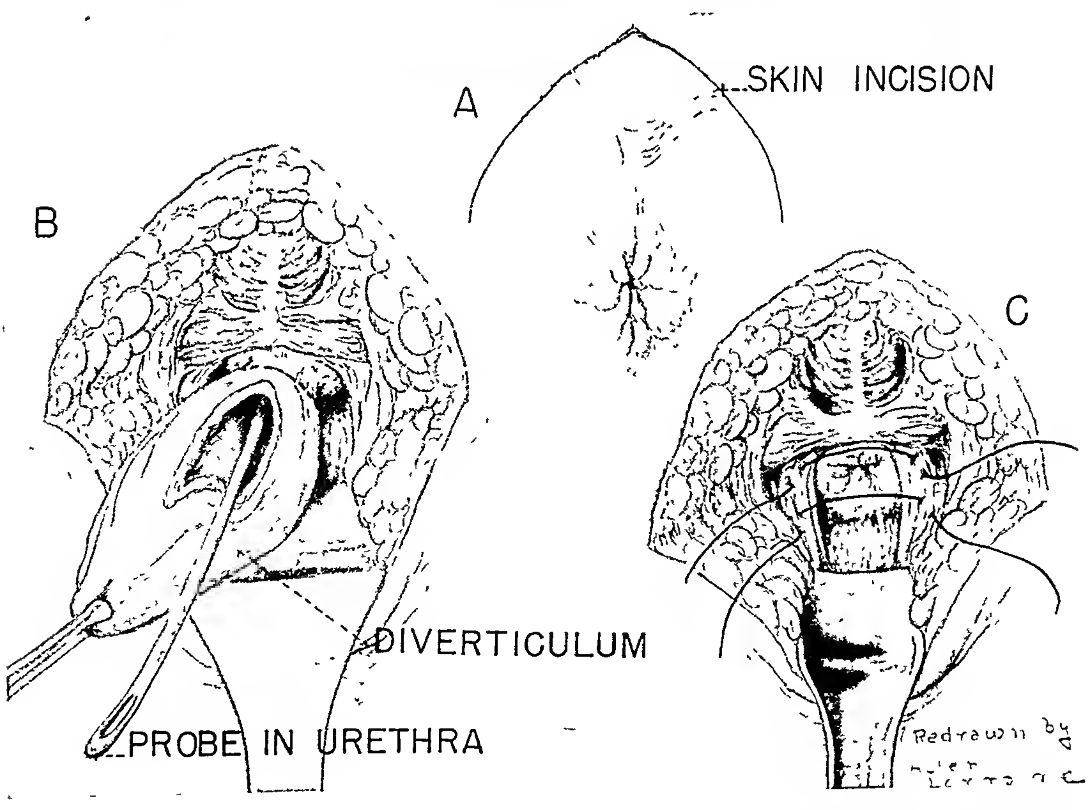

Fig 501 —Excision of diverticulum of posterior urethra *A*, Incision *B*, Dissection of diverticulum *C*, Urethral defect closed and sutures placed to approximate levator muscles over urethra (Redrawn from McKay and Colston, Surg, Gynec & Obst 48 51-62, 1929)

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CHAPTER XXXIV

INJURIES OF THE URETHRA AND THEIR TREATMENT

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Injuries of the urethra may be caused by a crushing type of force, by a tear from displaced fragments of the pubic arch, by penetrating objects or lacerations, or by false passages associated with urethral instrumentation. All injuries of the urethra are prone to be followed by troublesome strictures

Anatomically the segments of the urethra may be divided into the penile (or pendulous), the bulbous, and the posterior portions (membranous and prostatic). Treatment is dependent to some extent on the segment which is injured, although the principles involved are the same; namely, to maintain or restore continuity of the urethra, drain tissue in which there is extravasation of urine or infection, and temporarily divert the urinary stream when necessary.

PENILE URETHRA

Penetrating injuries or lacerations of the penile urethra deserve suture over a suitable-sized instrument, using loose plication of surrounding soft tissue and then closure of skin if there is sufficient tissue Fistula formation is more common in this area than in the bulbous portion. Although many urologists look with disfavor upon using a splinting catheter, my experience with a catheter in place following operation leads me to continue this practice. In fact, a period of drainage for several weeks seems preferable to a period of only a few days when the injury is severe.

Mild crushing injuries of the penile urethra which cause no difficulty voiding and are manifested only by minor urethral bleeding are best treated medically, although early dilatation is advisable within three weeks after injury because of the tendency toward stricture formation. Meatal strictures following trauma may require surgical revision (Fig 502.)

BULBOUS URETHRA

Injuries of the bulbous urethra are frequently caused by the straddle type of accident Perineal tissues including the bulbous muscles are traumatized, with resulting hematoma under Colles' fascia If urine is added, a tense mass develops in the anterior portion of the perineum and dissects forward to involve the scrotum and penis. The patient may find it difficult or impossible to void.

The location of the traumatized portion of the urethra can be determined by oblique urethrogram using an absorbable medium such as Skiodan. Preoperative localization of the lesion facilitates the proper surgical approach to the damaged area (Fig 503)

Prompt repair of the injured urethra offers the best chance for satisfactory recovery. The patient should be placed in lithotomy position and prepared for both a perineal and suprapubic approach. Tears in the anterior portion of the bulb can be easily approached through a midline incision, those farther back through a curved perineal incision. Blood and serum are evacuated. By passing a catheter from the external meatus the tear can then be visualized. One must attempt to find the posterior (proximal) segment of the urethra and pass the catheter on to the bladder for drainage. If the

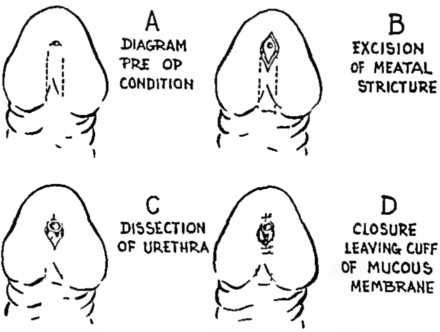


Fig 502 —Diagram of operation for correction of meatal stricture if dilation is not successful because of dense scar tissue (From Prather War Injuries of the Urinary Tract J Urol January 1946)

posterior end of the urethra cannot be found, a suprapubic cystotomy should be done immediately and a bougie or other instrument passed retrograde from the bladder to demonstrate the region of injury. When the posterior urethral segment is found the urethral catheter can be passed to the bladder. If complete rupture has occurred one or two absorbable sutures should be placed on the deep surface of the urethra to anastomose the torn ends before using sutures to close tissue superficial to the catheter (Figs 504 and 505) If cystotomy has had to be done the bladder should be drained suprapubically for a few days even though the urethral catheter is also draining. We urge that the splinting catheter be left in place for two to three weeks. Urethral dilatation or calibration must be begun within two weeks after the catheter is removed

Fig 503—Urethrogram and cystogram showing complete obstruction of urethra just posterior to penoscrotal angle after war injury of the urethra. All shell fragments are outside the urinary tract (From Prather War Injuries of the Urinary Tract, J. Urol, January, 1946)

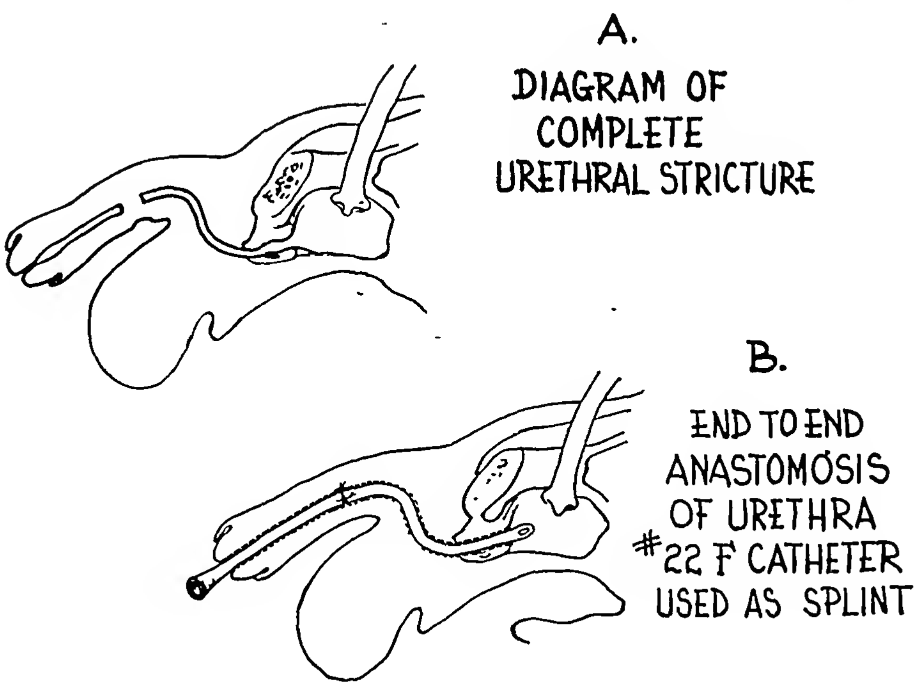
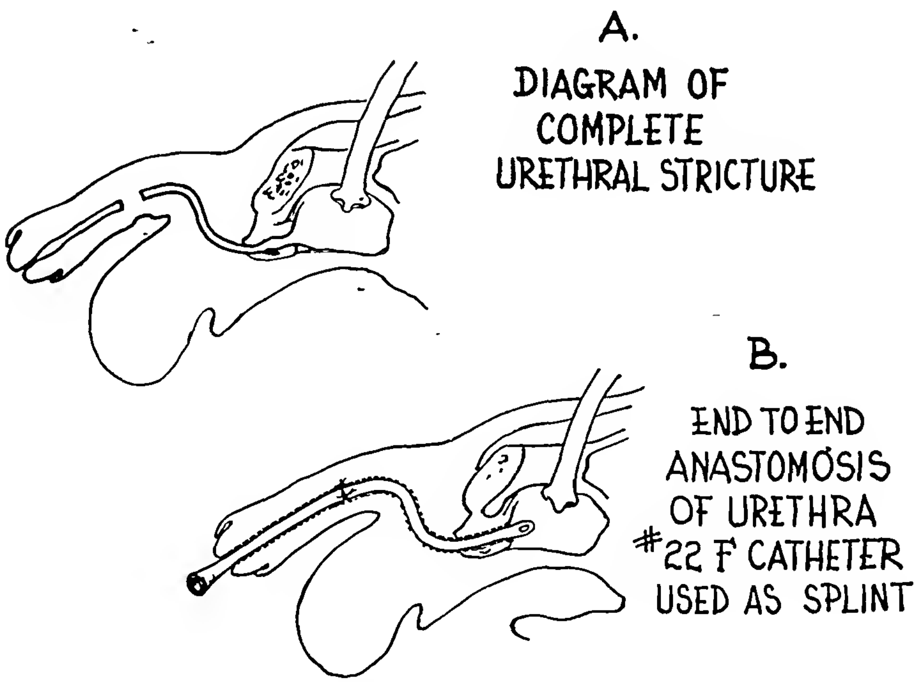


Fig 504—*A*, Diagram of problem shown in Fig 503 A complete traumatic stricture, 1 5 cm in length, was found

B, Diagram of end-to-end anastomosis of the urethra employed with success (From Prather War Injuries of the Urinary Tract, J Urol, January, 1946)

Fig 505—Urethrogram ten months after operation as in Fig 504 A and B showing urethral continuity without fistula This excellent result was maintained during several years follow up (From Prather War Injuries of the Urinary Tract J Urol January 1946)

Fig 503 —Urethrogram and cystogram showing complete obstruction of urethra just posterior to penoscrotal angle after war injury of the urethra All shell fragments are outside the urinary tract (From Prather War Injuries of the Urinary Tract, J. Urol, January, 1946.)



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B, Diagram of end-to-end anastomosis of the urethra employed with success (From Prather War Injuries of the Urinary Tract, J Urol, January, 1946)

The prostate may become separated from its distal attachment, hematoma filling the area where the prostate is normally located (Fig 507)

Patients with rupture of the deep urethra usually suffer suprapubic pain and have a desire to void Often there is bleeding from the external meatus Neglected cases show a phlegmon in the suprapubic region An attempt to catheterize the patient frequently demonstrates obstruction at the region of the injury and is followed by more profuse urethral bleeding than is normally associated with urethral calibration

Rectal examination may reveal a mass (hematoma) in the region where the prostate should be, and the prostate may be indefinitely palpated higher up A normally located prostate does not rule out trauma of the deep urethra

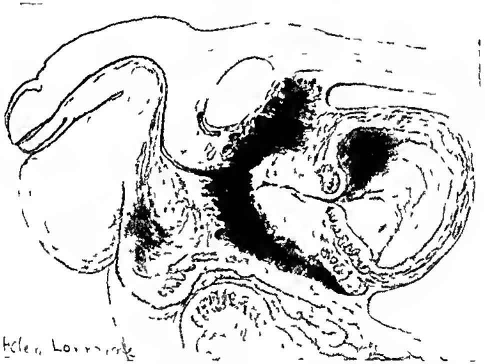

Fig 508 —Rupture of the posterior urethra with prostate and bladder displaced upward leaving space filled with extravasated blood

Urethrograms, using 30 c c of 10 20 per cent Skiodan Diodrast, or Neo Iopax and taken in the oblique and anteroposterior position will establish the diagnosis and localize the area of rupture

The aim of treatment is to avoid or overcome the shock hemorrhage, and extravasation associated with the immediate injury, to restore adequate continuity and caliber of the urethra divert the urinary stream temporarily, and by later periodic urethral dilatation to prevent contracture of the torn area

An attempt to obtain urinary drainage per urethral catheter should be made first, using aseptic technique The best chance of success is with a two holed (hollow tipped) catheter on a mandrin (stylet) molded in the curve of a urethral sound Success is evident by the rapid normal flow of urine via the catheter If successful the mandrin must be withdrawn, leaving the

DEEP URETHRA

Differentiation between ruptures of the deep urethra (prostatic and membranous portions) and the distal portion of the bladder (extraperitoneal) is at times difficult Both are urological emergencies and fortunately both can be treated through a suprapubic incision. Bleeding from the external urethral meatus, difficulty in passing a catheter to the bladder, profuse urethral bleeding during attempted catheterization, and the rectal finding of a displaced prostate favor injury of the deep urethra. During the suprapubic exploration, the discovery of a distended bladder furnishes additional evidence that a urethral injury is present.

Fig 506—Urethrogram and cystogram with intravenous urography showing severe rupture of the deep urethra with increased distance between the external sphincter and the base of the bladder

Rupture of the deep urethra commonly occurs in cases with fractured pelvis. Sudden displacement of the bones of the pelvis tears or completely severs the urethra at the junction of the membranous and prostatic portions at the apex of the prostate. This is above the triangular ligament. Hemorrhage and urinary leakage occurs in the prevesical and perivesical tissues and spreads to the suprapubic region instead of showing itself in the perineum When trauma is severe, extravasation may be evident in other tissues (Fig 506.)

The prostate may become separated from its distal attachment, hematoma filling the area where the prostate is normally located (Fig 507)

Patients with rupture of the deep urethra usually suffer suprapubic pain, and have a desire to void Often there is bleeding from the external meatus Neglected cases show a phlegmon in the suprapubic region An attempt to catheterize the patient frequently demonstrates obstruction at the region of the injury and is followed by more profuse urethral bleeding than is normally associated with urethral calibration

Rectal examination may reveal a mass (hematoma) in the region where the prostate should be, and the prostate may be indefinitely palpated higher up A normally located prostate does not rule out trauma of the deep urethra

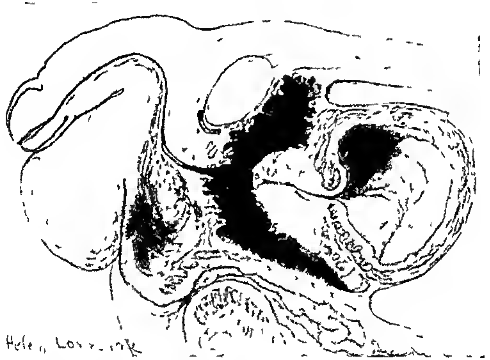

Fig 507—Rupture of the posterior urethra with prostate and bladder displaced upward leaving space filled with extravasated blood

Urethrograms using 30 cc of 10-20 per cent Skiodan Diodrast, or Neo Iopax and taken in the oblique and anteroposterior position will establish the diagnosis and localize the area of rupture

The aim of treatment is to avoid or overcome the shock, hemorrhage, and extravasation associated with the immediate injury, to restore adequate continuity and caliber of the urethra, divert the urinary stream temporarily and by later periodic urethral dilatation to prevent contracture of the torn area

An attempt to obtain urinary drainage per urethral catheter should be made first, using aseptic technique The best chance of success is with a two holed (hollow tipped) catheter on a mandrin (stylet) molded in the curve of a urethral sound Success is evident by the rapid normal flow of urine via the catheter If successful the mandrin must be withdrawn, leaving the

catheter for constant drainage. If suprapubic sepsis occurs it will need surgical drainage. The urethral catheter acts as a splint and should be left in place at least two weeks.

More frequently, and especially in cases of severe or complete rupture of the posterior urethra, it will be impossible to guide the urethral catheter into the bladder. Surgery will be necessary to provide urinary drainage.

A perineal approach, while suited for restoration of urethral continuity, may be contraindicated because of a fractured pelvis in which further distortion of bony fragments should be avoided.

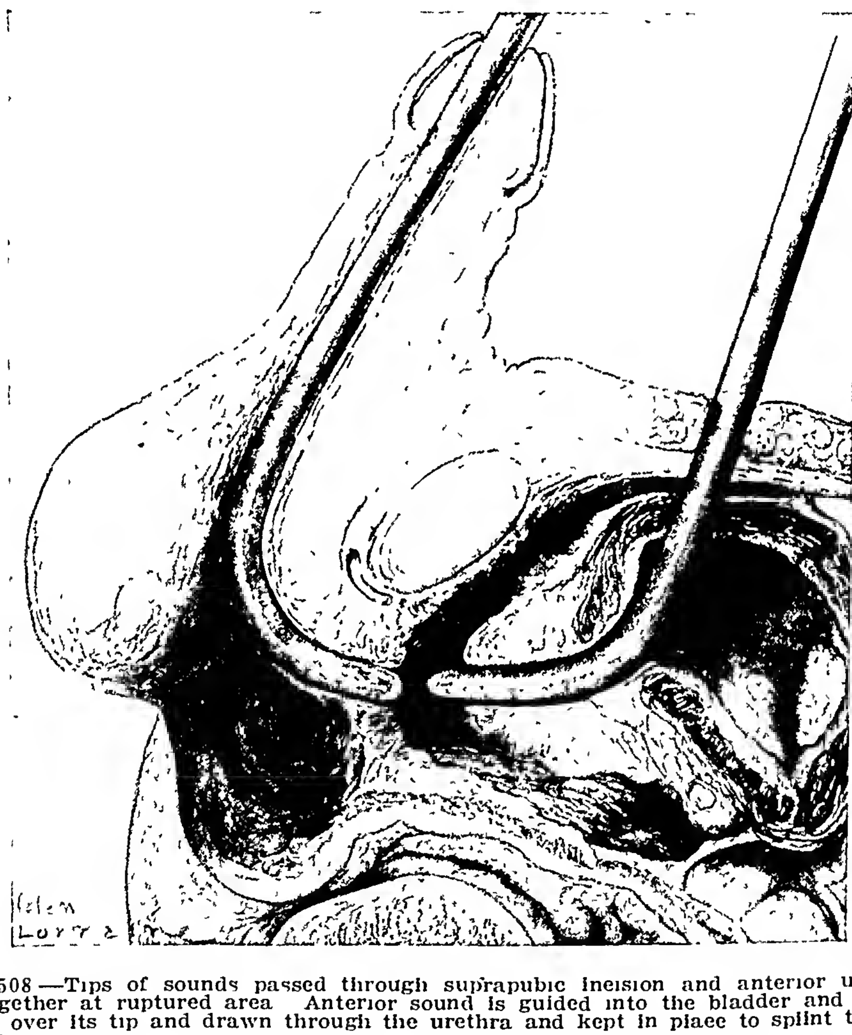

Fig 508—Tips of sounds passed through suprapubic incision and anterior urethra are brought together at ruptured area Anterior sound is guided into the bladder and a catheter is fastened over its tip and drawn through the urethra and kept in place to splint the urethra while healing occurs

Under these circumstances, suprapubic cystostomy to provide a urinary outlet becomes the immediate objective At the time of the cystostomy effort must be made to restore continuity of the urethra if the general condition of the patient is not precarious It may be possible to guide a styletted balloon catheter from the external meatus to the bladder If this can be done, the balloon of the catheter should be distended and the catheter placed on trac-

(Text continued on page 640.)

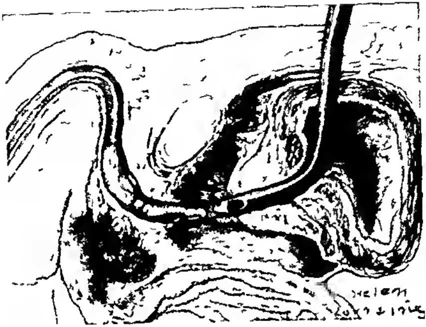

Fig 509.—Method of drawing balloon catheter into bladder through ruptured urethra suggested by C J Reynolds (Personal communication)

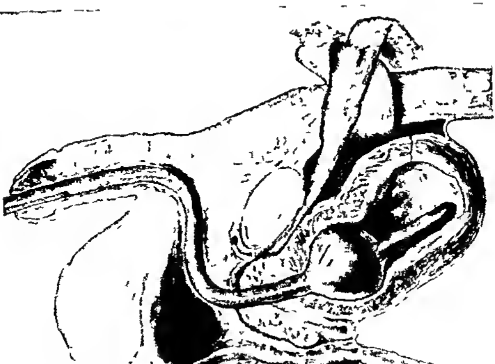

Fig 510.—Balloon inflated and catheter pulled down and fastened to thigh closing dead space and holding ends of ruptured urethra in accurate approximation Additional drainage by suprapubic tube in bladder is recommended (C J Reynolds Personal communication)

catheter for constant drainage. If suprapubic sepsis occurs it will need surgical drainage. The urethral catheter acts as a splint and should be left in place at least two weeks.

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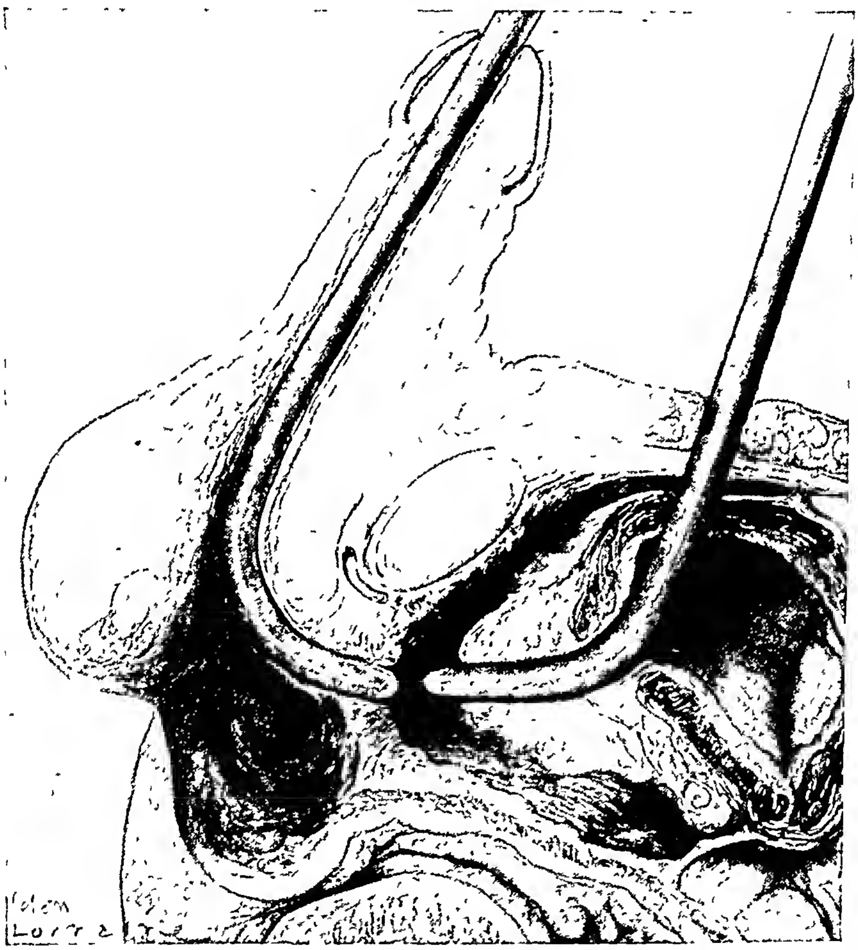

FIG 508.—Tips of sounds passed through suprapubic incision and anterior urethra are brought together at ruptured area. Anterior sound is guided into the bladder and a catheter is fastened over its tip and drawn through the urethra and kept in place to splint the urethra while healing occurs

Under these circumstances, suprapubic cystostomy to provide a urinary outlet becomes the immediate objective At the time of the cystostomy effort must be made to restore continuity of the urethra if the general condition of the patient is not precarious It may be possible to guide a styletted balloon catheter from the external meatus to the bladder. If this can be done, the balloon of the catheter should be distended and the catheter placed on trac-

(Text continued on page 640)

A

B

Fig 514—*A* Urethrogram in anteroposterior position of case in Fig 513 following reconstruction of the deep urethra by combined perineal and suprapubic approach *B* Urethrogram in oblique position of case in Fig 513 following reconstruction of the deep urethra

A.

B

Fig 513 —A, Urethrogram in anteroposterior position showing irregularity and distortion of posterior urethra following a penetrating war injury. B, Urethrogram in oblique position showing distortion and false channels of posterior urethra

Urethroscopic examinations should be made when patients complain of bleeding from the urethra, when strictures rapidly recur following dilatation and when there are areas of periurethral thickening If the epithelial surface of the urethra appears suspicious, tissue should be taken for biopsy It is a good practice to excise a piece of tissue for microscopic examination whenever a periurethral swelling is incised and it is particularly important to examine tissue from chronic indurated fistulous masses

Treatment —Excision of the tumor with a liberal margin of healthy tissue is the treatment of choice In very advanced cases suprapubic or perineal drainage of the bladder with x ray therapy may give good palliative results A review of the literature indicates that the results of treatment of urethral carcinoma have been extremely poor This should not be so if the disease is recognized reasonably early and treated radically

Carcinoma of the penile urethra should be treated the same as carcinoma of the penis If the growth is confined to the anterior third of the urethra, amputation of the penis about an inch posterior to the growth should be sufficient If the penile urethra is more extensively involved, the entire penis should be removed and the healthy urethral stump transplanted to the perineum The method of amputation described by Graves for carcinoma of the penis is satisfactory for such cases

Tumors of a low degree of malignancy in the anterior urethra when recognized before they have extended beyond the corpus spongiosum may be cured by dissecting the corpus spongiosum from the cavernous bodies, leaving that portion of the penis intact In one such case with multiple papillomas, I excised the urethra and the surrounding corpus spongiosum to within two inches of the triangular ligament and transplanted the urethral stump to the perineum This patient has been well more than fifteen years In such cases there is the possibility of reconstructing the urethra as in hypospadias

Carcinoma of the bulbous portion of the urethra can usually be excised even in well advanced cases without the necessity of removing the penis Lower has reported two cases in which the involved portion of the urethra was excised and an end to end anastomosis made with satisfactory results These patients were alive eight and nine years, respectively, following the operation Braasch and Scholl reported a case in which a portion of the urethra was excised and later replaced by a section of the saphenous vein The patient was alive five years later

The most satisfactory operation for tumor in the perineal portion of the urethra is that described by H H Young in which a block dissection is done, removing the tumor with a section of the cavernous bodies of the penis in one mass The anterior stump of the penis is then drawn backward until an end to end anastomosis of the urethra can be made Young's operation is carried out in the following manner With the patient in the position for perineal prostatectomy, an incision is made in the midline from the base of the scrotum backward for a distance of about 6 centimeters The incision is carried down to Colles' fascia which is isolated on each side of the urethra to the ischiopubic

CHAPTER XXXV

CARCINOMA OF THE MALE URETHRA AND ITS TREATMENT

Carcinoma of the male urethra is a comparatively rare condition. It may involve any portion of the urethra, probably the bulbous portion most frequently. There is a history of stricture or repeated trauma, such as the passage of sounds, in a sufficient number of cases to suggest chronic irritation as a causative factor.

Squamous cell carcinomas are by far the most frequently encountered, although columnar cell tumors, papillary tumors, and adenocarcinomas are occasionally reported. Stratified squamous epithelium is normally found only in the fossa navicularis but prolonged irritation and stricture formation are accompanied by a change in the epithelium to the stratified type. Adenocarcinomas probably arise from Cowper's glands and are not true urethral tumors. Most urethral tumors grow rather slowly and metastasize late. Metastasis is to the inguinal or iliac nodes. In the opinion of Young and Davis if the growth is posterior to the suspensory ligament of the penis, there is little probability of metastasis to the inguinal nodes.

The chief obstacles to an early diagnosis are the rarity of the disease and the frequent history that urethral irritation or stricture has existed for a long time. Urethral discharge, urethrorrhagia, and diminution of the urinary stream are often noted in stricture and rarely excite suspicion of a more serious lesion. Periurethral abscess is not an unusual complication of stricture and is reported in most cases of carcinoma of the urethra. Not infrequently a urethral fistula is present, particularly if the abscess has been incised. In the penile urethra there is swelling and sometimes cyanosis of the penis. In some cases there is persistent priapism. Fistulas to the ventral surface are not unusual. Occasionally the growth can be seen protruding from the urethra. Tumors of the perineal portion of the urethra are almost always first recognized as a mass in the perineum which is usually believed to be a perineal abscess. In fact the malignant tissue is often infected and in some cases infiltrated with urine. One patient that I have treated for carcinoma of the urethra consulted a urologist because of hematuria and difficulty in urinating. A median bar was found and resected. When a mass was noted in the perineum a few days later it was believed to be extravasation from urethral trauma and was incised. Healing did not occur and a fistula formed which persisted until the tumor was recognized and excised. Another patient was admitted to the hospital because of a dense stricture with infiltration of the perineal tissues. An external urethrotomy was done and the stricture divided; a portion of the indurated tissue surrounding the urethra was excised. The true condition was recognized by the pathologist.

Fig 518—Appearance of perineum twelve months following Young's operation for carcinoma of the urethra

Fig 519—Anterior view showing slight telescoping of the penis following Young's operation for carcinoma of the penis

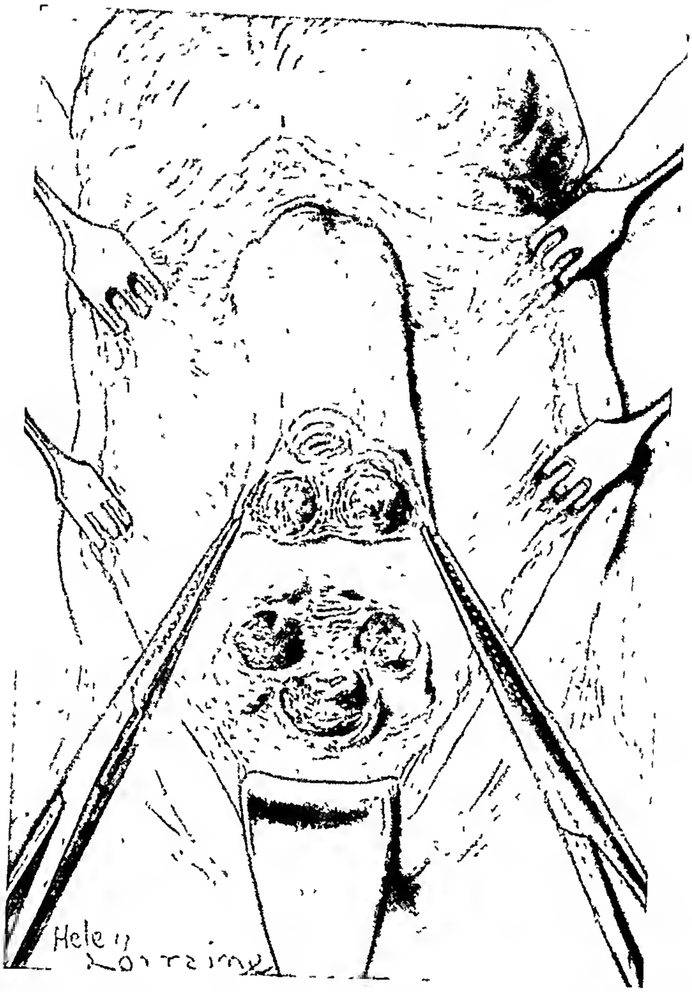

Fig 515—Young's operation for carcinoma of the urethra The tumor is exposed by a median perineal incision and removed by block dissection including a section of the penis. The anterior portion of the penis is liberated and drawn backward closing the defect

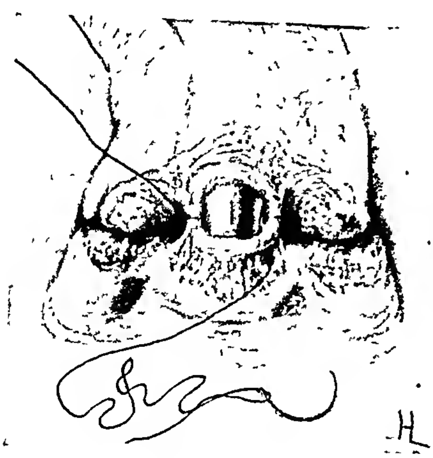

Fig 516

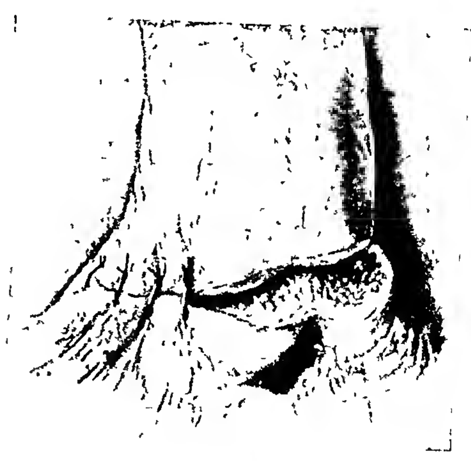

Fig. 517.

Fig 516—The anterior urethral stump is anastomosed to the posterior stump by a continuous suture of fine chromic catgut

Fig 517—The stump of the penis is sutured to the stumps of the crura with interrupted sutures of No 1 chromic catgut; the wound is closed with drainage

As the fascia is pulled outward and the dissection continued backward, the crura of the corpora cavernosa are exposed and divided close to the ischiopubic rami. The urethra can be palpated as it leaves the bulb and penetrates the triangular ligament. A clamp is then passed beneath the urethra posterior to the posterior limits of the tumor and an incision is made through the bulb and urethra, leaving as much healthy urethra anterior to the triangular ligament as possible. In the case reported by Young the incision was made through the bulb

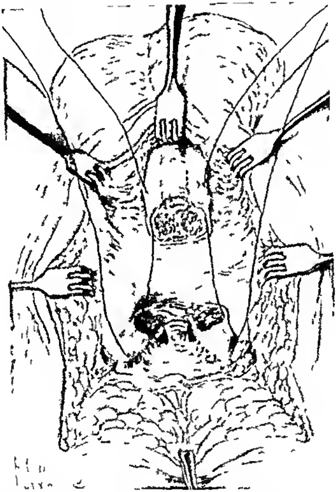

Fig 5 1—Carcinomatous tissue and section of the penis have been removed. Interrupted sutures are taken from sheath of penis to sheath of crura. Dotted line over urethra indicates urethral flap to be turned back to help bridge gap between the divided ends of the urethra. (Dodson, Transactions American Association of Genito Urinary Surgeons, 1940.)

just in front of its posterior limit and about one centimeter of healthy urethra was left in front of the triangular ligament. The entire carcinomatous mass is then removed together with a portion of healthy tissue at both ends.

Bleeding is controlled. The fascia surrounding the anterior stump of the penis is grasped with forceps and the penis is pulled backward until the cut ends of the urethra can be approximated (Fig 515). The penis is thereby telescoped within the scrotal pouch. The cut ends of the urethra are anastomosed with a

ramus. With the scrotum retracted well forward, blunt dissection is continued downward outside the fascia covering the corpora until a point about two centimeters below the lower margin of the induration is reached. A clamp is then passed around the cavernous bodies and their fascia and a transverse incision is made through the corpus spongiosum and corpora cavernosa in front of the anterior margin of the indurated area This completely severs the penis in the

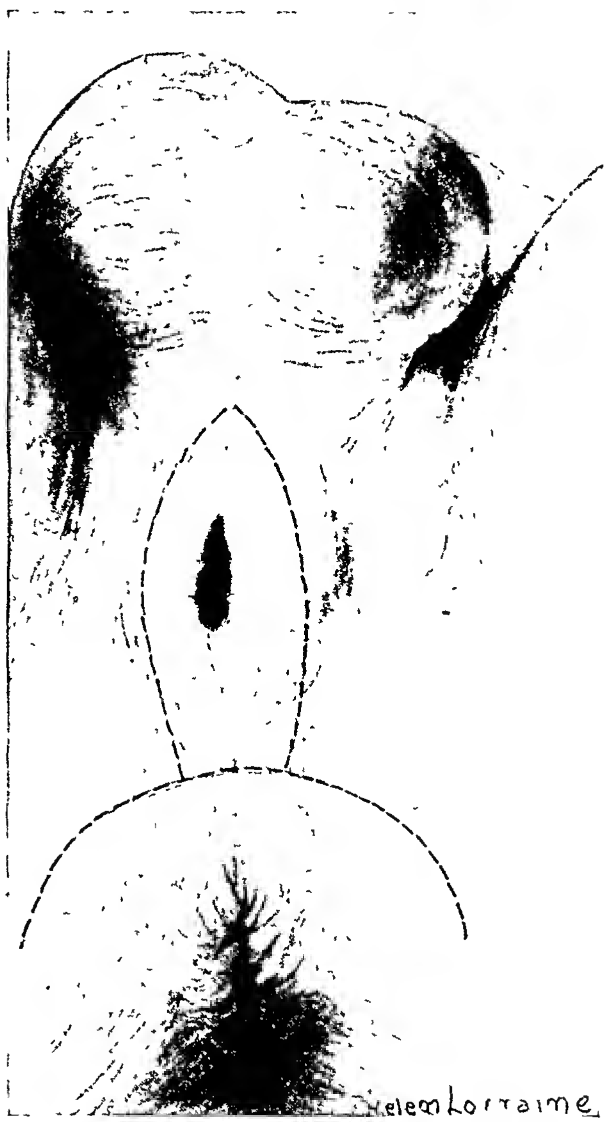

Fig 520 —Carcinoma of the bulbous urethra with fistula of the urethra Dotted lines indicate lines of incision (Dodson. Transactions American Association of Genito-Urinary Surgeons, 33 211-220, 1940)

posterior portion of the scrotum. The fascia covering the posterior stump of the cavernous bodies is then grasped with forceps and pulled forward and freed by blunt and sharp dissection Fibers of the suspensory ligament are divided and adhesions to the anterior surface of the pubis and the ischiopubic rami are divided close to the bony structures The dorsal veins and artery are divided and ligated.

As the fascia is pulled outward and the dissection continued backward, the crura of the corpora cavernosa are exposed and divided close to the ischiopubic rami The urethra can be palpated as it leaves the bulb and penetrates the triangular ligament A clamp is then passed beneath the urethra posterior to the posterior limits of the tumor and an incision is made through the bulb and urethra, leaving as much healthy urethra anterior to the triangular ligament as possible In the case reported by Young the incision was made through the bulb

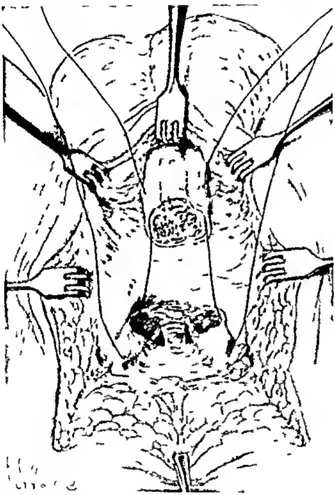

Fig 521—Carcinomatous tissue and section of the penis have been removed Interrupted sutures are taken from sheath of penis to sheath of crura Dotted line over urethra indicates urethral flap to be turned back to help bridge gap between the divided ends of the urethra (Dodson Transactions American Association of Genito Urinary Surgeons 1940)

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Bleeding is controlled The fascia surrounding the anterior stump of the penis is grasped with forceps and the penis is pulled backward until the cut ends of the urethra can be approximated (Fig 515) The penis is thereby telescoped within the scrotal pouch The cut ends of the urethra are anastomosed with a

continuous suture of fine catgut. A catheter is introduced just before the urethral anastomosis is completed (Fig. 516). The cavernous bodies and surrounding fascia are then fixed in place with interrupted sutures of plain catgut, some of which are placed in the stumps of the crura on the structures of the triangular ligament (Fig. 517). In the case reported by Young, there was a distance of nine centimeters between the two stumps of the urethra and only

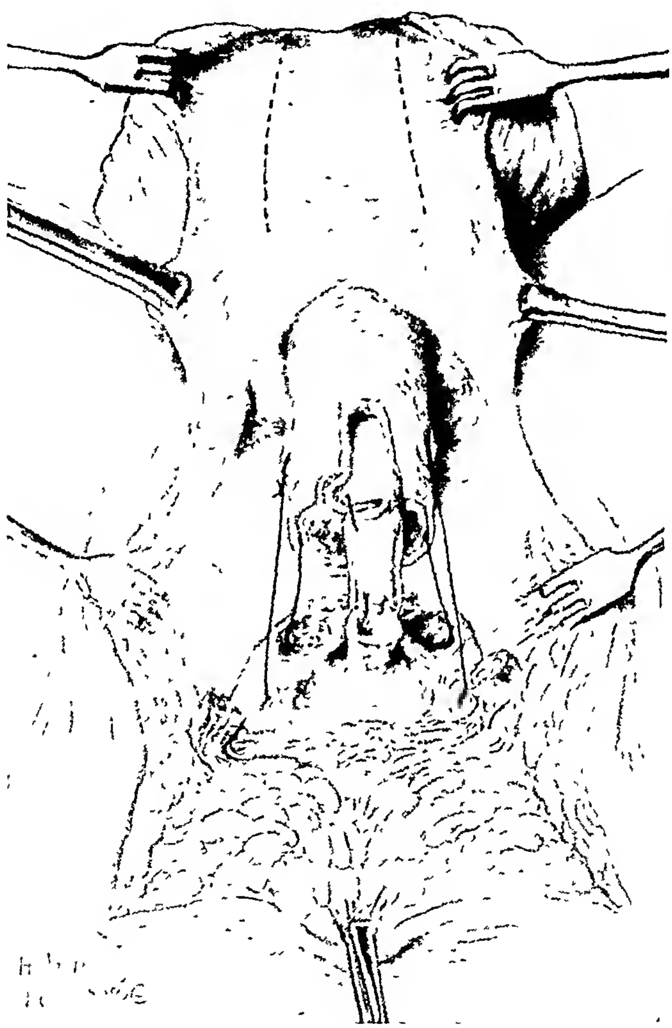

Fig 522—Urethral flap turned back and sutured to stump of bulbous urethra. The scrotum has been divided in the midline Dotted lines indicate flap of scrotal fascia to be turned back as a fascial covering for the urethral defect (Dodson. Transactions American Association of Genito-Urinary Surgeons, 1940)

the glans penis was visible after the anastomosis was completed. The subcutaneous tissues are approximated with interrupted sutures of plain catgut and the skin is closed with interrupted sutures of nonabsorbable material. I have operated upon one patient by Young's method and the results were entirely satisfactory. The patient remained in good health for about five years but eventually died of local recurrence (Figs. 518 and 519).

Before the description of Young's operation was published, I had resected a portion of the bulbous urethra for carcinoma in a somewhat similar manner, but had closed the urethral defect by turning down a flap from the anterior urethral stump and covering the anastomosis with a graft of scrotal fascia (Figs 520 525) The principal difference in the dissection was that crura and urethra were first approached posteriorly An inverted U shaped incision was made just above the anus and two elliptical incisions were carried from the highest point of

Fig 523—Scrotal fascia dissected up and turned into the wound (Dodson Transactions American Association of Genito Urinary Surgeons 1940)

the inverted "U" incision, circumscribing a fistulous opening in the center of the carcinomatous mass and joining near the base of the scrotum (Fig 520) The posterior flap was dissected back until the transversus perinei muscles were exposed The dissection was then carried forward, exposing Colles' fascia to the ischiopubic rami well beyond the anterior limit of the area of induration, as has been described in Young's operation The attachment of the bulbocavernosus muscle to the central tendon was divided and the dissection continued until the

bulb and crura of the corpora cavernosa were exposed. These structures were divided and as the indurated mass of tissue was retracted outward and forward, the dissection from the anterior structures was made in the reverse direction to that described in Young's operation. When the dissection had been carried well anterior to the diseased area, the corpora were divided transversely and the tumor mass was removed After this was done the cut ends of the urethra were separated by about three centimeters.

Fig 524—Fascia is sutured in place (Dodson' Transactions American Association of Genito-Urinary Surgeons, 1940)

After controlling the bleeding, the anterior stump of the penis was liberated for a short distance and interrupted sutures of No. 2 chromic catgut were taken on each side through the fascia of the anterior stump and through the stumps of the crura (Fig 521). When these sutures were tied under moderate tension, the penis was drawn backward and the space between the urethral segments was diminished by half. It can be readily seen that by liberating the penis further forward and dividing the posterior fibers of the suspensory ligament accurate approximation could have been made as in Young's operation. A flap was turned

back from the lateral wall of the anterior stump of the urethra and the free end was sutured to the posterior urethral stump, bridging the gap between the ends of the urethra on the upper wall (Fig 522) The scrotal skin was then divided in the midline up to the penoscrotal area and the scrotal fascia, including all the layers down to the tunica vaginalis, was dissected up from the scrotum anteriorly and laterally, leaving the base attached (Fig 523) This flap of fascia was turned into the defect produced by the dissection and sutured over the urethral

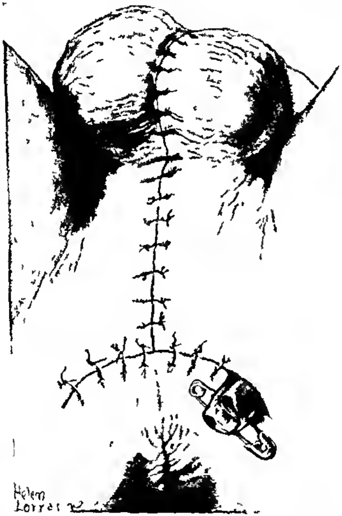

Fig 525 —The skin and superficial fascia are closed with interrupted sutures of coarse silk or cotton (Dodson Transactions American Association of Genito Urinary Surgeons 1940)

defect, forming lower and lateral walls of the newly made portion of the urethra (Fig 524) A catheter for drainage of the bladder had been inserted previously through the urethra and fixed in place

The wound was closed in layers, suturing the subcutaneous tissue with interrupted sutures of No 1 chromic catgut and the skin with interrupted non absorbable sutures A rubber tissue drain was placed in the wound and brought out at one angle of the U shaped portion of the incision (Fig 525)

This patient made a good recovery and remained well more than twelve years. For the first twelve months the repeated passage of sounds was necessary to prevent stricture.

In most cases Young's operation will be more satisfactory, but this procedure is described not only to demonstrate the posterior approach to the urethra, which will be more satisfactory when the tumor is situated in the posterior portion of the bulbous urethra, but to show the value of the scrotal fascia as a supporting structure in closing urethral defects.

Dissection of the inguinal nodes is not necessary in every case of carcinoma of the urethra. In robust individuals with carcinoma of the pendulous urethra, inguinal dissection is probably a good precaution. Certainly if nodes are palpable, they should be removed either at the time the penis is amputated or at a second operation. If no nodes are palpable there is little risk in keeping the patient under close observation and removing a node for examination if there is evidence of metastasis later. In view of the fact that when the tumor is situated in the bulbous area, metastasis is more apt to occur to the iliac nodes, there seems little wisdom in excising the inguinal nodes in these cases. Neither of my patients showed any evidence of metastasis. However, the first of these patients died of local recurrence six years following his operation. The second patient died of unknown cause more than twelve years following operation.

Radiation therapy is a valuable adjunct to the treatment of urethral carcinoma. In both of the patients upon whom I operated, preliminary x-ray treatment very decidedly reduced the size of the mass. In one case the operation would have been very difficult before the treatment was given. When the disease is too far advanced to permit surgical treatment, x-ray should be used as a palliative measure Postoperative irradiation is indicated only when complete eradication of the tumor is in doubt.

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CHAPTER XXXVI

SURGICAL CONDITIONS OF THE FEMALE URETHRA AND THEIR TREATMENT

Traumatic and Postoperative Injury, Epispadias, Hypospadias, Diverticulum, Urethrovaginal Fistula, Prolapse of Urethra, Caruncle, Tumors

The female urethra is a much less complicated structure than that of the male, and serves as a part of the urinary system only. Surgical operations are required for the treatment of incontinence of urine, urethral prolapse, excision of diverticula, repair of fistulas, and excision or destruction of new growths.

Incontinence of urine is the result of disturbances of the nervous system or of injury or maldevelopment of the sphincter muscles. Disturbances of the nervous mechanism causing incontinence of urine are not amenable to surgical treatment and should be differentiated by appropriate neurological examinations.

INJURY

Severe injuries of the sphincter muscles are rare. Occasionally the urethra is partly detached and torn by the blades of obstetrical forceps or by fracture of the pelvis. O'Conor mentions an injury of the urethra caused by a child sitting on a croquet mallet, the handle breaking and piercing the vagina and urethra. I repaired an injury in which the lateral wall of the urethra was excised with an infected Bartholin's cyst. There was almost complete incontinence. When these cases of severe injury are seen early, immediate repair should be attempted. After the devitalized tissue is trimmed away, the wound is carefully closed, each structure being approximated as accurately as possible. Fine chromic catgut is probably the most satisfactory suture material. If the condition is seen after the lapse of days when the structures are distorted and infected, it is better to wait until healing has occurred before attempting to repair the defect. The scar tissue is then carefully dissected away and the different layers of the urethral canal are accurately approximated.

In all cases in which an extensive plastic operation has been done on the urethra the urine should be diverted from the urethra until healing is complete. Vaginal cystostomy is a very satisfactory method of accomplishing this. At the beginning of the operation a curved hemostat is passed into the bladder and the point of the hemostat made to depress the base of the bladder just behind the trigone. A short incision is made through the vaginal wall, exposing the point of the hemostat which is thrust through, grasps the tip of a catheter, and draws it into the bladder for about an inch. A suture of nonabsorbable material is then taken in the vaginal wound and the ends are tied around the catheter to fix it in place. The catheter is also fixed to the thigh for greater security when the operation is completed. This catheter may be left in place two or three weeks without danger of a fistula.

STRESS INCONTINENCE

Stress incontinence is a condition in which urine is expelled involuntarily following exertion such as arising from a sitting position, coughing, lifting a heavy object, or other types of physical exertion. Incontinence varies from the loss of a few drops of urine to almost complete incontinence during exertion. Stress rarely occurs in early life as a result of developmental defects. Most frequently it occurs in postpartum patients as a result of obstetrical injuries to the support of the bladder or the vesical sphincter, and is at times seen in the multiparous patient, occasionally the bachelor girl, cause undetermined, probably postmenopausal atrophy

John C. Ullery, following an exhaustive study of this condition, has concluded that incontinence results from "failure to maintain closure of the internal orifice under conditions of exertion or stress" or failure of the bladder and urethral supports (ligaments, fascia and muscles) in preventing descensus of the neck of the bladder and urethra, under stress.

Lawrence R. Wharton found that stress incontinence occurred most frequently in patients past 40 years of age; two-thirds of his patients were overweight and most of them had borne children. There was evidence of lack of bladder support in 40 per cent of his patients, varying from moderate relaxation of the anterior vaginal wall to complete prolapse. Other patients with advanced prolapse or cystocele had complete urinary control

It seems evident, as attested by numerous investigators, that the bladder and urethra in the female are held in position by fascial structures of the superior layer of the pelvic diaphragm. Relaxation or laceration of this fascia permits the bladder orifice and urethra to descend from its normal position behind the pubis, thereby causing or contributing to stress incontinence. In the opinion of some investigators, this is almost the sole cause This hypothesis is difficult to justify, since a very large percentage of patients are relieved of their incontinence by exercises designed to strengthen the sphincter muscles by the treatment of accessory pathological conditions, such as trigonitis, urinary tract infections, or a urethral stricture, and by simple plication of the muscles at the bladder sphincter area by the method devised by Howard A. Kelly

The diagnosis of stress incontinence should be based upon a careful history, with particular reference to the patient's general health, the date of onset of incontinence and its relation to childbirth, surgical procedures, menopause, and variations in normal weight During the physical examination, particular attention should be given to muscle tone, gait reflexes or other variations that might suggest disturbance of the central nervous system. Careful attention should be given to the pelvic structure, with reference to the presence of tumors or undue relaxation of the pelvic outlet.

The urethral elevation test was first performed by Bonney, who found that by supporting the bladder neck by digital pressure, involuntary escape of urine while straining or coughing was prevented In the United States this is known as the Marchetti test when modified by making a wheal of Novocain at a point believed to be under the interuteric ridge and grasping the vaginal mucosa with an Allis forcep. If firm pressure on the forceps upward toward the um-

bilicus maintains control under stress, such as cough or strain when the bladder is moderately distended, the incontinence should be controlled by restoring urethro vesical support

A complete urological examination should be made to determine the condition of the kidneys and ureters and the presence or absence of lesions in the bladder or urethra A cystometrogram should be done to determine the tone of the bladder, and a cystogram included, with exposures taken at different angles and with the bladder at rest and voiding to determine the relation of the bladder orifice and urethra to the symphysis

Treatment —Probably three fourths of the patients with stress incontinence can be cured or greatly benefited by nonsurgical treatment The relief of trigonitis, urethritis and urethral stricture often restores the balance between the detrusor mechanism and the bladder sphincter sufficiently to restore continence The tone of the perineal and sphincter muscles can be improved by exercise The exercises consist in voluntarily tightening the vesical and rectal sphincters as though to control or prevent the elimination of urine or gas, and to repeat these exercises 15 to 20 times at definite intervals several times a day A H Kegel devised a perineometer consisting of a pneumatic, cylindric diaphragm which fits into the vagina, serving as a resistance chamber upon which the vaginal muscles can contract The force of the contractions is transmitted to a manometer through a rubber tube connecting the two Kegel believes this visual evidence to the patient of the force of contractions and the improvement under exercise is productive of better results until the patient learns to contract the perineal muscles adequately Wharton believes that the exercises can be explained and understood without the aid of mechanical devices and reports cures or marked improvement in 75 per cent of patients treated Complete failures were associated with senility nervous disorders and those afflicted with severe cough Kegel reported that 84 per cent of 500 patients treated were restored to normal control

SURGICAL TREATMENT

Lawrence R Wharton credits Andrew A Marchetti with the statement that he has found in the literature "approximately 95" surgical procedures for the cure of stress incontinence This indicates to some extent the difficult task of surgical relief, although many of these procedures are very similar and variations represent personal preference as a different interpretation of surgical anatomy Reis and DaCosta after studying various surgical procedures, concluded in 1947 that all of them have in common the tightening of the fascial planes through which the urethra and vagina pass

All of the surgical procedures fall in two general types one in which the surgical approach is through the vagina and one in which an abdominal approach is used The vaginal approach is to be preferred in the minor degrees of incontinence and when incontinence is complicated by uterine prolapse relaxed vesical sphincter, or cystocele The operation has for its purpose strengthening the fascial supports of the urethra and base of the bladder and repairing or strengthening by plication the relaxed or torn muscles at the bladder sphinc

ter area The suprapubic operations all consist of some method of giving support to the urethra and bladder orifice. These procedures are more apt to be successful in the more severe degrees of stress incontinence, especially when the "Marchetti test" is positive. Suprapubic approach may also be used to advantage when intra-abdominal surgery is also indicated and when transvaginal plication has failed. Only those procedures commonly used in my practice will be given in detail. Those who desire a greater variation of procedures should study the very excellent monograph on the subject by Dr John C Ullery.

Since Goebell, in 1910, described a method of transplanting the pyramidalis muscles beneath the urethra, numerous operations have been described, using muscles and fascia or both, designed to give support to and to narrow

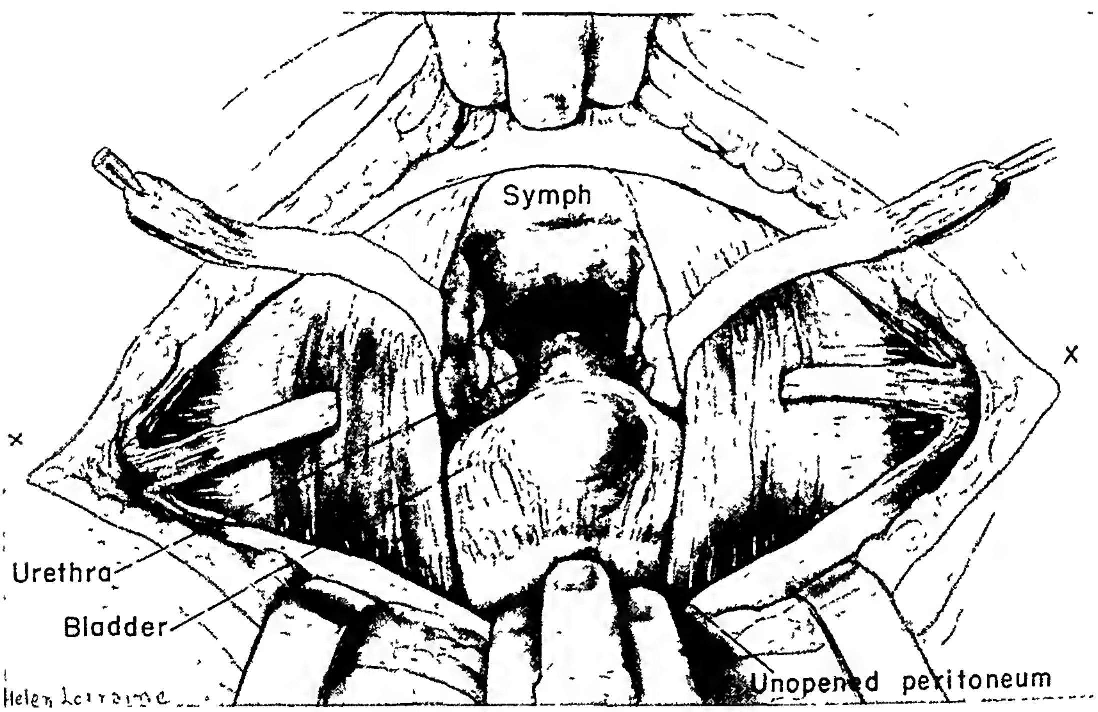

Fig 526—Transverse incision has been made and the urethra exposed Transverse aponeurotic flaps have been dissected up and carried through the middle of each rectus muscle (Ullery Stress Incontinence, Grune & Stratton, New York, 1953)

the urethral canal and to restore the relation of the posterior angle of the bladder to the urethra The most recent and probably the most frequently used operation of this type is that described by Millin and Reed, in which a transverse suprapubic incision is made. Transverse aponeurotic flaps are dissected up, the base of each flap situated within 2 cm of its corresponding anterior superior spine. The bladder neck and upper urethra are now carefully dissected away from the pubis. This dissection is made easier by an indwelling Foley catheter, the bag of which outlines the exact location of the vesical sphincter The lateral surfaces of the urethra are dissected from the vagina. The urethra is not completely isolated from the vagina posteriorly where adhesions are dense The aponeurotic straps are now carried through the middle of each rectus muscle (Fig 526), and with the thumb and fore-

finger elevating the urethra, the end of one strap is grasped with a curved forceps which is thrust through the urethrovaginal septum about two centimeters below the bladder neck. The end of this strap is held by a hemostat while the blades of the curved forceps passed beneath the urethra are slowly opened and closed until an adequate tunnel is made to accommodate the strap from the opposite side. The straps crossed beneath the urethra are sutured together on either side with nylon sutures after it has been determined that the bladder neck is not unduly elevated. The ends of the straps may then be excised or, preferably, brought through the recti muscles at the medial third and the ends sutured to each other (Fig. 527). A rubber tissue drain is then placed in the retropubic space and brought out through a stab wound in the inferior flap. The wound is closed in layers, using chromic catgut in the aponeurosis and silk in the skin. Since the edges of the aponeurosis come together under tension, it is helpful to flex the thighs while the wound is being closed.

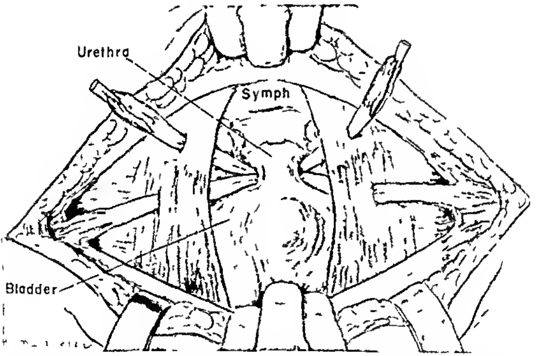

Fig. 527.—The aponeurotic flaps have been crossed beneath the urethra and the ends brought through the recti muscles. They are to be sutured together as they emerge from beneath the urethra. The ends are then united over the recti muscles. (Ullery: Stress Incontinence, Grune & Stratton, New York, 1953.)

The Marshall Marchetti Operation

In 1949 Marshall, Marchetti and Krantz described an operation for stress incontinence which consisted of elevating the urethra and bladder orifice by suturing the anterior wall of the vagina, urethra and bladder orifice to the posterior surface of the pubis. After placing a Foley catheter with a 30 c.c. balloon in the bladder transurethrally (I find a 5 c.c. balloon quite adequate), the patient is placed in moderate Trendelenburg position and a suprapubic

ter area The suprapubic operations all consist of some method of giving support to the urethra and bladder orifice These procedures are more apt to be successful in the more severe degrees of stress incontinence, especially when the "Marchetti test" is positive Suprapubic approach may also be used to advantage when intra-abdominal surgery is also indicated and when transvaginal plication has failed Only those procedures commonly used in my practice will be given in detail Those who desire a greater variation of procedures should study the very excellent monograph on the subject by Dr. John C. Ullery

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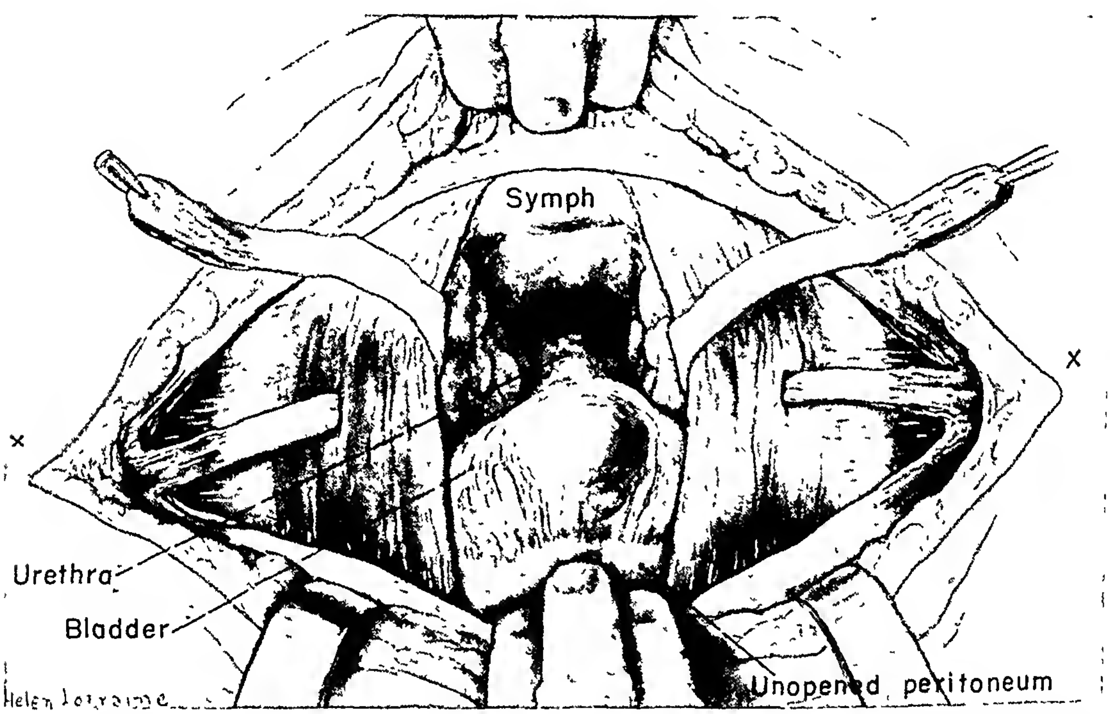

Fig 526—Transverse incision has been made and the urethra exposed Transverse aponeurotic flaps have been dissected up and carried through the middle of each rectus muscle (Ullery Stress Incontinence, Grune & Stratton, New York, 1953)

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tional sutures are then placed in the lower and lateral portions of the bladder wall and attached to the posterior portion of the rectus muscles, there tied to further pull the bladder anteriorly into the space of Retzius (Fig 530) A small rubber tissue drain is placed into the depths of the wound and the wound closed

In our experience, this operation has been more satisfactory than those using fascial straps The support is more evenly distributed and there is less danger of complications arising from improper adjustment of the support and from injury of the urethra When the bladder orifice is markedly relaxed, plication of the muscles of the orifice and posterior urethra from above may be done Following the operation, the indwelling catheter should be left in place about a week to afford drainage and bladder rest

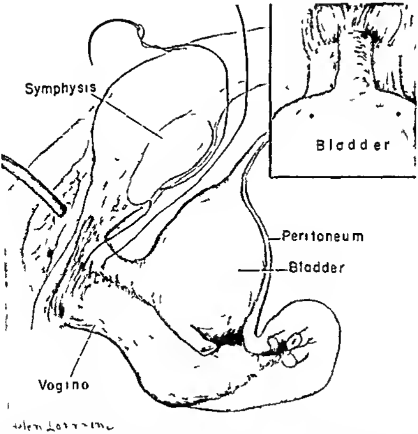

Fig 529 —Diagrammatic illustration of method of placing sutures Dots on inset show approximate position of sutures Only two sutures indicated in urethral margin Marshall uses three (Ullery Stress Incontinence Grune & Stratton New York 1953)

In cases of flabby, thin sphincter muscles, relief is usually obtained by Kelly's method of plicating the sphincter muscles The patient is placed in the lithotomy position and a small 5 c c Foley catheter is passed into the bladder The posterior vaginal wall is retracted An incision about three inches long is made through the anterior vaginal wall down to the urethra and bladder The bladder orifice should be opposite the center of the incision which is made in the median line The position of the bladder orifice can be determined by

incision is made to expose the space of Retzius (Fig. 528). The bladder and urethra are then separated from the posterior surface of the rectus muscles and pubis by gentle blunt dissection to within one centimeter of the urethral orifice. An assistant's finger may be used in the vagina to aid in palpation of the catheter and balloon which identify the urethra and bladder orifice, respectively. Three sutures of No. 1 chromic catgut are then placed equidistant on either side of the urethra (Fig. 528). The sutures are placed deeply in the upper wall of the vagina adjacent to the urethra and through the lateral wall of the urethra, being careful not to enter the urethral lumen A double bite is then taken to ensure a secure hold and to place as large amount

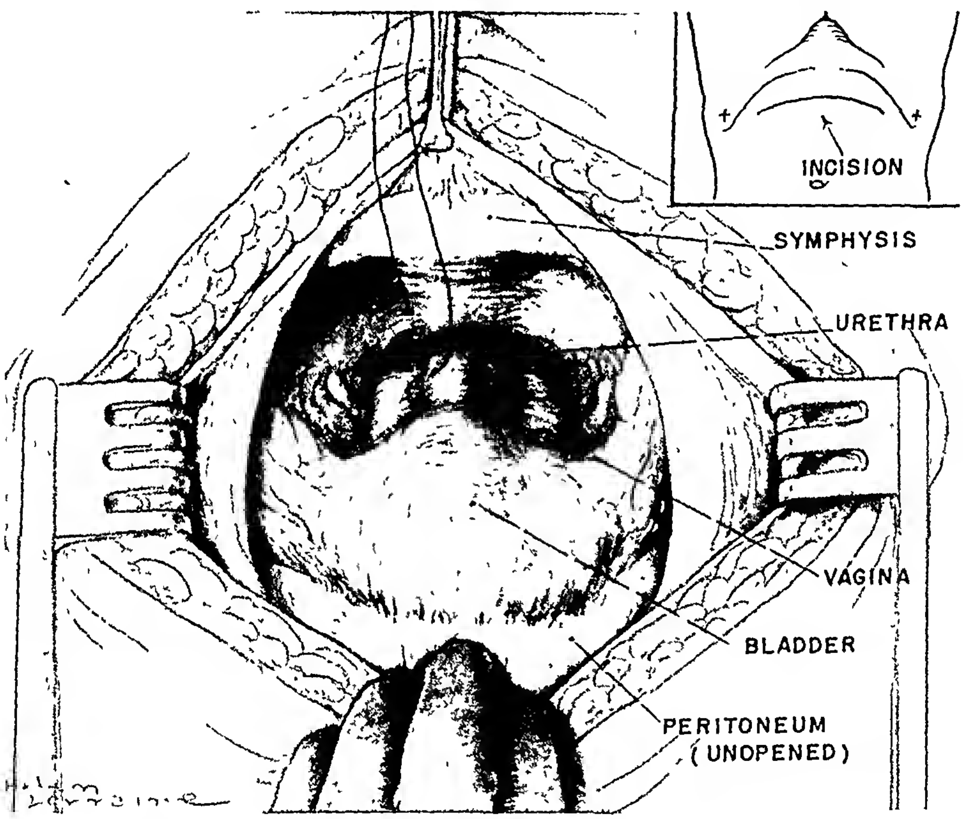

Fig 528—Vagina and bladder, urethra, and margins of vagina exposed. First suture has been placed in urethra Additional sutures, including those at vesical outlet and in anterior wall of bladder, to be placed. (Ullery Stress Incontinence, Grune & Stratton, New York, 1953.)

of tissue as possible in apposition to the pubis The balloon is pulled down to mark the vesical outlet and similar sutures are placed on both sides of the vesical outlet (Fig. 529) Upward traction is then made on these eight sutures lifting the urethra and vesical neck away from the introitus. With a curved, round-edged needle the long ends of these sutures are attached securely to the periosteum of the symphysis, especially to the cartilage of the symphysis when feasible. The locations of these sutures are carefully selected so that when they are tied the urinary passage will be moved upward and backward from the introitus This closes the space of Retzius and opposes a wide area of the urethra and bladder neck to the posterior surface of the symphysis Addi-

Lowsley has modified the Kelly plication operation by plicating the roof of the urethra instead of the floor and using ribbon catgut With a sound in the urethra a curved incision is made above the urethral meatus and the dissection is continued backward, exposing the anterior and a portion of the lateral walls of the urethra to the bladder The muscles of the bladder orifice and posterior portion of the urethra are plicated by two rows of ribbon catgut sutures catching bites well down on the lateral surfaces of the bladder orifice and urethra When the sutures are tied these muscles are plicated in front of the sphincter and urethra When all sutures are tied the urethra is drawn up to the symphysis by catgut sutures to eliminate the dead space A rubber wick is placed and the incision closed with nonabsorbable sutures This operation has the disadvantage that frequently the muscles are injured and thin posteriorly Consequently a posterior plication would be expected to give a better result I have used Lowsley's operation with good results One patient has complete control of urine and the other has control unless the bladder becomes distended

EPISPADIAS

Incontinence resulting from deformities of the urethra is more difficult to treat There is partial or complete absence of sphincter muscles and frequently extensive defects in the urethra occur Deformities of the female urethra are rare as compared with those of the male urethra Epispadias and hypospadias are occasionally encountered In either case the defect may be barely noticeable or may involve the entire urethra with complete incontinence of urine

Epispadias is accompanied by division of the clitoris and usually by separation of the upper portion of the vulva Lack of union of the symphysis and diastasis of the recti muscles are also present in advanced cases Treatment is not required in those cases with normal bladder function Plastic operations to unite the clitoris or to correct the deformity of the vulva are occasionally done by the gynecologist At the same time the defect in the superior wall of the urethra may be closed by uniting flaps from the urethral margins

If the defect is so advanced that there is partial or complete incontinence of urine there are three possible methods of treatment (1) An effort may be made to reconstruct the vesical sphincter and to restore the urethral canal, (2) the urethral canal may be restored and muscles from a distance transplanted to serve as a sphincter, (3) the ureters may be transplanted to the rectum

The operation for reconstruction of the vesical sphincter was devised by H H Young The bladder is opened suprapubically and a section is removed from the superior part of the bladder orifice extending through the remains of the urethra The dissection is carried down onto the sides of the bladder neck until thick muscle bundles are reached The roof of the bladder orifice and urethra are then closed, including the muscle which is sutured together in the midline (Figs 439 442) The bladder orifice is thereby reduced to a normal state The wound in the bladder is closed, leaving a suprapubic tube for drainage The distal portion of the urethra can usually be reconstructed from flaps obtained from the margins of the furrow representing the defective portion

feeling the head of the catheter as it is pulled snugly against the orifice. The vaginal wall is dissected from the bladder and urethra for about an inch on each side of the incision. The dissection is carefully carried upward on the sides of the bladder and urethra until two-thirds of the bladder neck and urethra can be grasped between the fingers. It is important in making the dissection that none of the muscle tissue about the bladder orifice be injured. The slightest degree of cystocele, if present, should be corrected.

The torn or relaxed tissues at the neck of the bladder are then sutured together by two or three mattress sutures of fine chromic catgut (Kelly used silk or linen). I have used ribbon catgut in the second layer in recent years. There

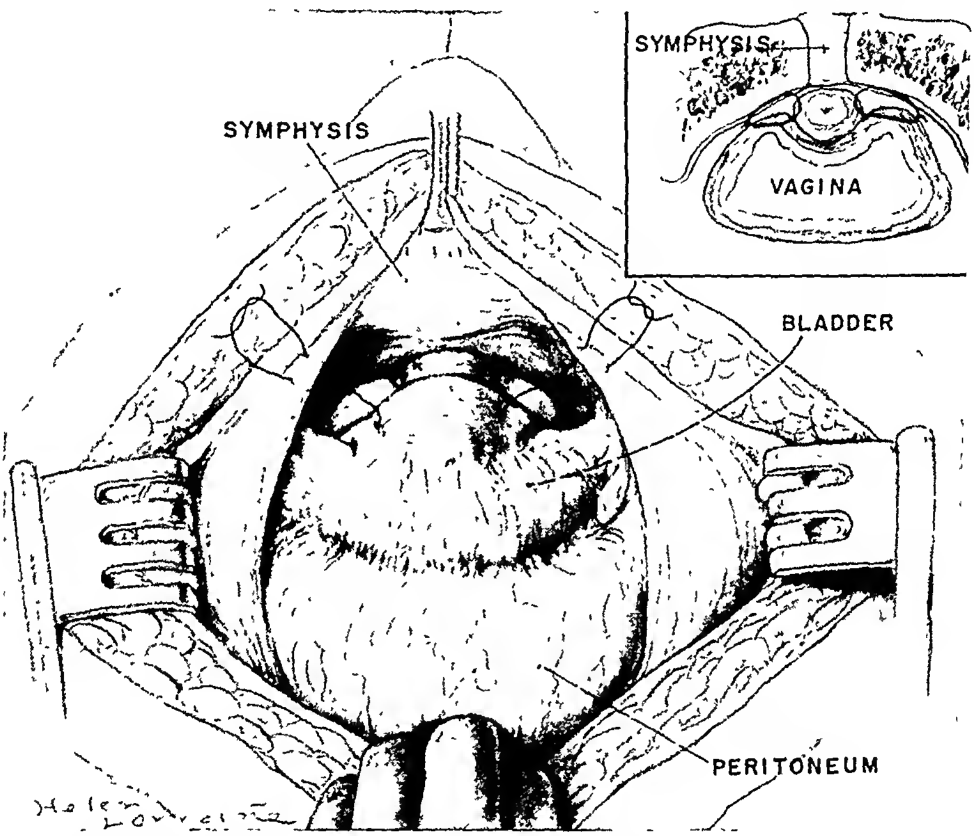

Fig 530—Sutures fixing urethra and bladder orifice have been tied, sutures placed from lateral wall of bladder to recti muscles to give additional support (Ulmer Stress Incontinence, Grune & Stratton, New York, 1953)

is less tendency for the suture to cut through The first suture takes about 1.5 cm. of tissue. The second, and if necessary a third, suture is taken outside of the first suture, further contracting the bladder orifice. A No. 14 F. catheter should fit very snugly in the urethra. A portion of one of the flaps that had been dissected free to expose the sphincter area should be resected so that the remaining tissue can be brought together snugly to give support to the area operated upon and eliminate any dead space. These flaps may be satisfactorily united by two layers of 0 chromic catgut sutures Kelly recommended catheterization when necessary in the aftercare of these patients. Most surgeons prefer a small indwelling catheter for a few days.

Some variation of Miller's modification is usually used Norman F Miller modified the operation by carrying the musculofascial flap anterior rather than posterior to the pubis The patient is placed in the lithotomy position and draped so that the entire operative area is exposed A median abdominal incision is made extending from below the navel over the pubis and downward through the upper part of the labia on one side to a point near the under surface of the urethra Bleeding is controlled and the incision below the pubis is lightly packed with gauze Above the pubis the fat is dissected from the anterior rectus sheath for an inch on both sides of the midline A strip from the anterior rectus fascia about 2 cm wide is dissected up with the attached portion of the pyramidalis muscle The dissection is begun just below the navel and extends to the pubis This musculofascial flap is turned downward and lies in the incision that extends over the mons and down to the urethra

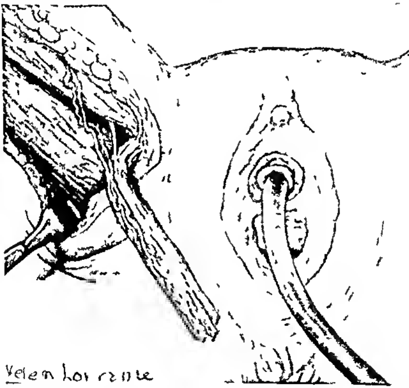

Fig 533 —Loughnane s modification of the Deming operation for transplantation of the gracilis muscle in the treatment of incontinence in the female The muscle has been exposed divided longitudinally and a strip dissected free to be transplanted around the urethra The blood vessels and nerves supplying the graft have been preserved The urethra has been dissected free

The anterior vaginal wall is then exposed and an incision is made over the ventral portion of the urethra from a point near the orifice to the bladder sphincter area The urethra is exposed and carefully dissected free (Fig 531) The end of the flap is split and one part is pulled beneath the urethra on one side and one on the other These ends are then crossed beneath the urethra as near the bladder as practical and sutured to one another and to the urethra (Fig 532) Hamner modified Miller s operation splitting the flap to its pubic attachment and tunnelling the tissues anterior to the pubis from the suburethral

of the urethra. I have used this operation effectively in complete epispadias of the male In the female it is more adaptable in partial incontinence where there is not complete absence of the anterior wall of the urethra.

In the second procedure mentioned, an effort is made to obtain urinary control by constructing a sphincter from portions of neighboring muscles. The operation is usually reserved for those cases in which plastic operations upon the urethra and vesical sphincter have failed to effect satisfactory bladder control. The two muscles usually utilized for this purpose are the pyramidalis and gracilis.

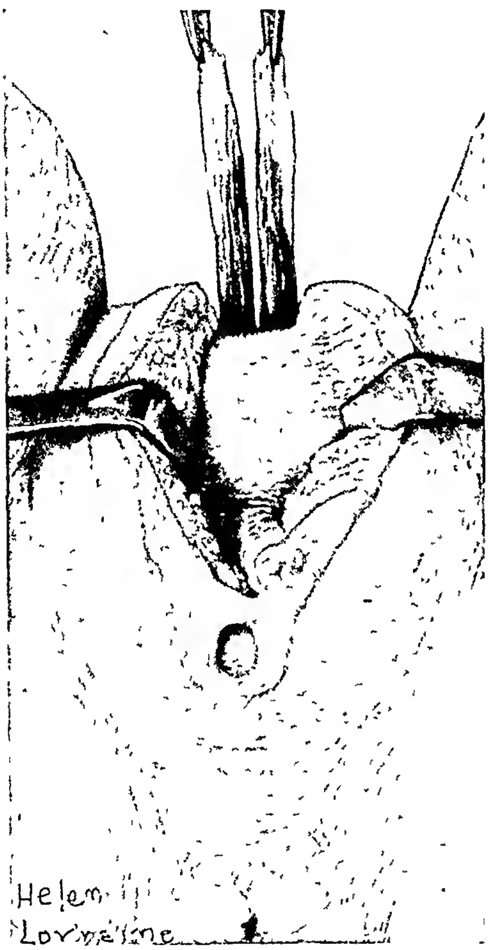

Fig 531

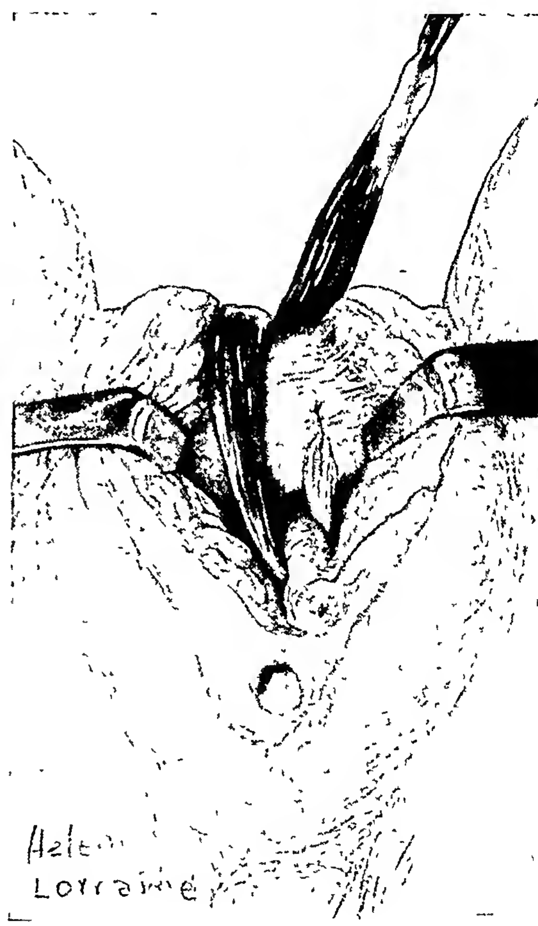

Fig 532

Fig 531 —The Miller modification of the Goebell-Stoeckel operation for incontinence of urine in the female Strips of fascia from the anterior sheath of the recti muscles with the attached fibers of the recti and pyramidalis muscles are dissected free and brought over the pubis to be sutured around the urethra.

Fig 532 —The flaps of muscle and fascia are crossed beneath the urethra and the ends sutured to the periosteum of the pubis. The fascia and fat are then sutured over the graft.

The transplantation of the pyramidalis muscle for the relief of incontinence is designated the Goebell-Stoeckel operation As originally done, the operation consisted of freeing a portion of the pyramidalis muscle with its attached fascia and suturing the free end around the bladder sphincter area and first portion of the urethra. The muscle is carried down behind the pubis. This operation has been modified to some extent by almost every surgeon who has performed it.

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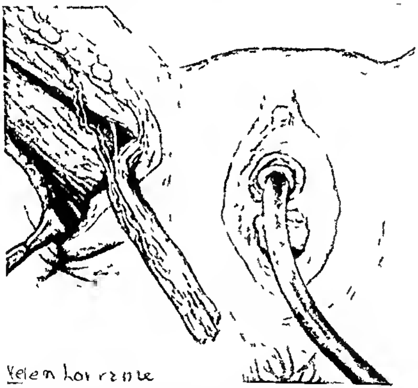

Fig 533 —Loughnane's modification of the Deming operation for transplantation of the gracilis muscle in the treatment of incontinence in the female The muscle has been exposed divided longitudinally and a strip dissected free to be transplanted around the urethra The blood vessels and nerves supplying the graft have been preserved The urethra has been dissected free

The anterior vaginal wall is then exposed and an incision is made over the ventral portion of the urethra from a point near the orifice to the bladder sphincter area The urethra is exposed and carefully dissected free (Fig 531) The end of the flap is split and one part is pulled beneath the urethra on one side and one on the other These ends are then crossed beneath the urethra as near the bladder as practical and sutured to one another and to the urethra (Fig 532) Hamner modified Miller's operation, splitting the flap to its pubic attachment and tunnelling the tissues anterior to the pubis from the suburethral

incision to the lower angle of the abdominal incision on both sides of the midline. A musculofascial flap is pulled through each tunnel and the ends are crossed and sutured beneath the urethra. The ends of the flaps are then sutured to the subpubital fascia on each side of the urethra.

By bringing the pyramidalis flap in front of the pubis considerably less dissection is necessary. Bleeding is more easily controlled and there is less liability of infection. In this operation there is little probability that any real sphincteric action is obtained. The muscle and fascia doubtless serve chiefly as support to the urethra.

Deming proposed the use of the gracilis muscle to form a urethral sphincter and obtained control of the urine in a patient with epispadias who had previously had a plastic operation which adequately lengthened the urethra but failed to relieve the incontinence.

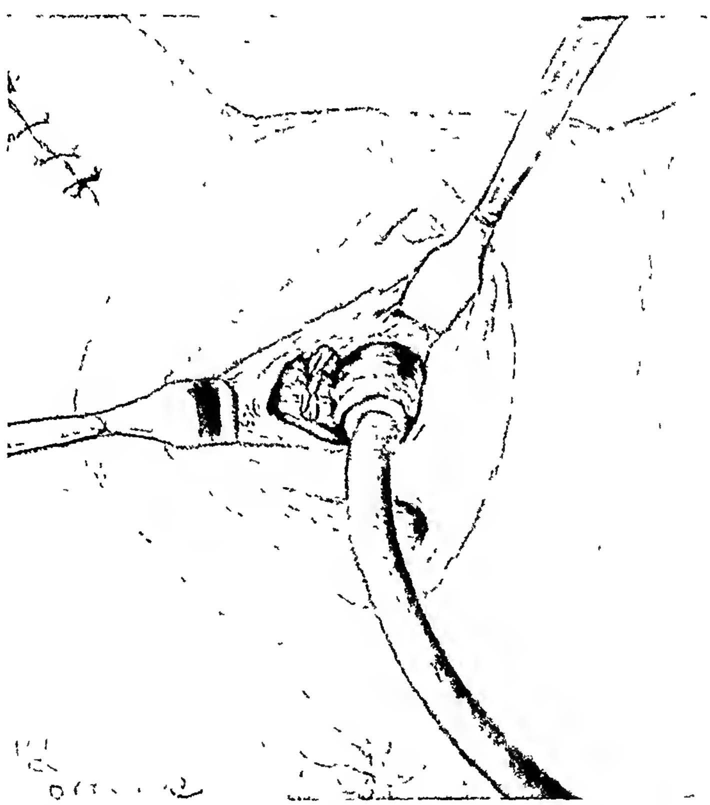

Fig 534.—The muscle graft has been drawn through a tunnel beneath the skin and the end sutured around the urethra The operation is completed by suturing the urethral meatus to the vestibule of the vagina

Deming's operation is done by making an incision from the pubic spine downward over the middle of the thigh. The fascia lata is opened and the gracilis muscle traced downward well toward the knee. The muscle, which has a double nerve supply, is divided between the two areas of nerve supply. The proximal portion is then wrapped around the urethra, which has been dissected free in preparation for the transplant and in which a catheter is inserted. The ends of the muscle after it has been wrapped around the urethra are sutured to itself and to the undersurface of the pubic arch. The wound is then closed

and the bladder drained until healing is complete Loughnane's modification differs from Deming's original operation in that a longitudinal section of the gracilis muscle is used An incision is made over the gracilis muscle which is divided longitudinally and a strip from the muscle is used to wrap around the urethra A tunnel is made from the upper end of the thigh incision near the groin to connect with the area around the urethra and the strip of muscle is pulled through the tunnel and fastened around the urethra as described by Deming It is important in dissecting out the muscle to preserve the nerve and blood supply which enters the muscle in its upper third (Figs 533 and 534)

Transplantation of the ureters into the sigmoid or rectum is usually reserved for those patients who have not obtained relief from plastic operations about the bladder orifice and urethra In cases of severe deformity this operation offers the most satisfactory solution

HYPOSPADIAS

Hypospadias is less frequently seen than epispadias The urethral orifice is situated on the anterior vaginal wall posterior to the normal location The defect is rarely extensive and the sphincter mechanism is usually intact There may be stenosis of the meatus with symptoms of urethral stricture The treatment required is dilatation of the meatus If there is incontinence of urine, the surgical treatment is similar to that described for epispadias The defect in the urethral channel is closed by turning down flaps from the vaginal mucous membrane and the muscles at the bladder sphincter area are plicated in the hope of restoring continence If this fails, muscle transplants or ureterosigmoidostomy should be done, depending upon the extent of the deformity

DIVERTICULUM

Diverticulum of the female urethra although occasionally congenital usually results from trauma or the rupture of a cyst or abscess into the urethra Repeated childbirth causing weakness or injury of the urethral musculature is a plausible etiologic factor The communication of a cyst or abscess with the urethral lumen is not a true diverticulum but the symptoms and the treatment are the same, consequently differentiation is unnecessary The patient usually complains of frequent and painful urination, a purulent urethral discharge or dribbling following urination A protrusion can be seen beneath the urethral meatus or a fluctuant mass can be palpated on the anterior wall of the vagina along the course of the urethra (Figs 535 and 536) Pressure over the mass may cause urine or purulent material to appear at the meatus The diagnosis is confirmed by passing a probe through the urethral meatus into the pouch, by observing the orifice of the diverticulum through a urethroscope, or by making a urethrogram, which has the advantage of showing the exact extent and outline of the sac

The treatment consists of dissecting out the diverticulum or cyst wall as the case may be and suturing the rent in the urethra

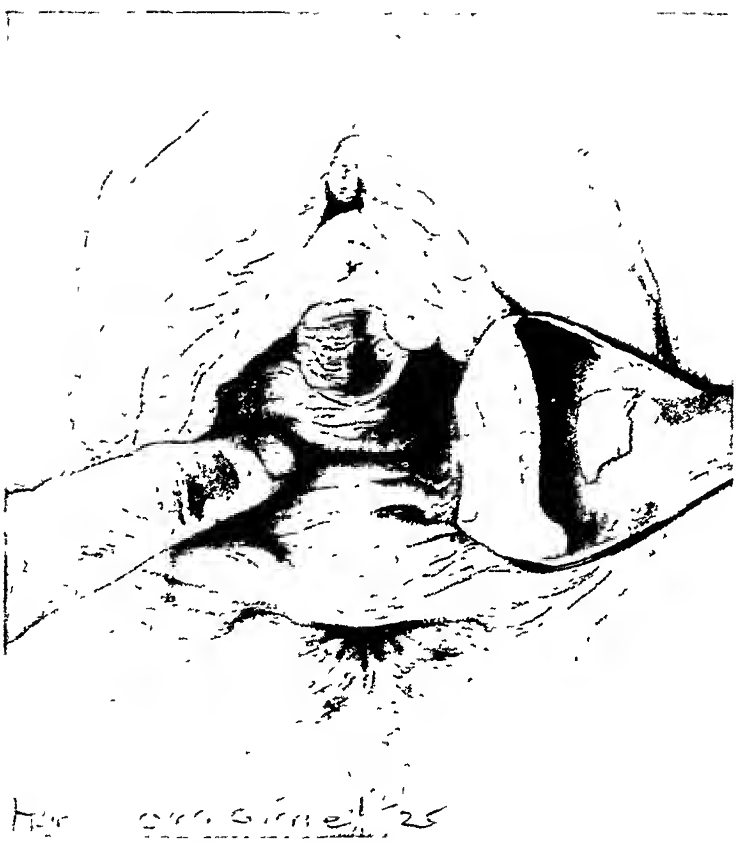

Fig 535 —Diverticulum of the urethra.

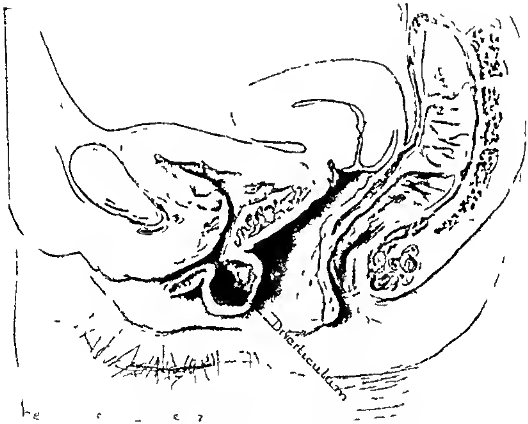

Fig. 536.—Sagittal section of the female pelvis illustrating diverticulum of the urethra seen in Fig. 535.

growth is covered by stratified squamous and transitional epithelium and usually shows diffuse inflammatory change. A caruncle is red or purplish in color and bleeds easily.

The diagnosis is rarely difficult. An extremely sensitive congested polypoid structure protruding from the urethral meatus is quite characteristic. The patient often complains of severe pain on walking or sitting and coitus may be impossible. Prolapse of the urethra involves the entire circumference of the meatus, is rarely so tender, and is usually of much shorter duration. Papillomas are at times confused with caruncles. They are less vascular and are not painful or sensitive. Carcinomas of the urethra are rare and when they occur the urethra is somewhat brawny or indurated on palpation. All growths removed from the urethra should be submitted to microscopic examination.

The papillary growths are easily removed by clamping the base with a small narrow-bladed forceps and excising the growth with the high-frequency knife or a small cautery. Care must be taken to fulgurate or cauterize the base thoroughly to prevent recurrence

The sessile growths have a broad base frequently occupying half or more of the circumference of the meatus. In this type of growth we prefer the method described by Deming. An incision extending through the mucosa and submucosa is made to encircle the meatus at the junction of the mucous membrane of the urethra with that of the vestibule (Fig 538). The mucosa and submucosa are dissected free to a point just behind the posterior margin of the growth. The separated mucosa is split back to the limit of the dissection at an area free from growth and a suture is taken securing the mucous membrane of the urethra to that of the vestibule (Fig 539). As the dissected portion of the urethra is trimmed away, the wound is closed with interrupted sutures of fine chromic catgut (Figs 540 and 541). This prevents retraction of the urethral wound. In this way the growth is easily removed and a healthy meatus remains (Fig 542). We have never seen a recurrence following this operation

Papillomas of the urethra probably occur more frequently near the meatus, although they may occur in any portion of the urethral mucosa. I treated one patient whose urethra was almost occluded by papillomas which occupied the entire length of the urethra. They resemble the warty growths which are found beneath the prepuce and sometimes in the anterior urethra of the male. They are frequently mistaken for caruncle. The patient seeks relief because of frequency or difficulty of urination or hematuria.

These tumors are more satisfactorily removed by the high-frequency current, thoroughly fulgurating the base. When they are situated deep within the urethra, removal must be done through a urethroscope.

Polyps in the female urethra are usually found around the margins of the bladder orifice and in the proximal portion of the urethra. They may grow from a fairly broad base or from a narrow pedicle. Polyps are probably the product of prolonged infection of the bladder and urethra and do not require specific treatment unless they are numerous or large. The symptoms may be

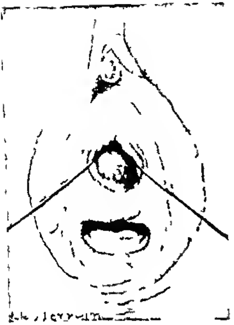

Fig 538

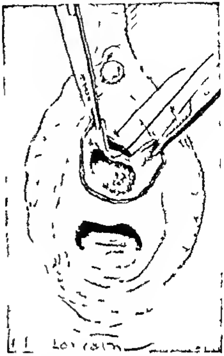

Fig 539

Fig 538 —Excision of caruncle Dotted line indicates line of incision which is carried through the submucosa

Fig 539 —The urethra has been dissected from to a point just behind the caruncle The meatus has been split back to healthy tissue and a suture is taken in the angle fixing the urethral mucosa to that of the vestibule

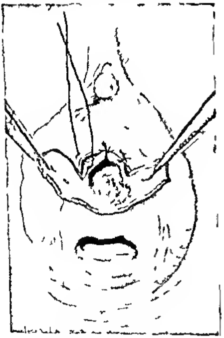

Fig 540

Fig 541

Fig 540 —As the diseased portion of the urethra is excised interrupted sutures of No 0 chromic catgut are taken to prevent retraction of the urethra

Fig 541 —The wound is closed as the growth is excised

bladder discomfort, frequency, tenesmus, and burning which should subside when the underlying cause is corrected. When there are many large polyps, convalescence is hastened by destroying them with a fulgurating electrode.

Carcinoma.—Carcinoma of the female urethra as compared with benign tumors is rare. The growth usually develops in the mucosa of the urethra and in most cases is classified as a squamous cell epithelioma. Adenocarcinoma occasionally arises from the periurethral glands. Carcinoma of the urethra may appear as an ulcerative, papillomatous or infiltrative growth The latter is the most common type and is characterized by brawny thickening of the walls of the urethra. The tumor often begins near the meatus and extends toward the bladder until the entire urethra is involved. The growth metastasizes first to the inguinal nodes and later to the deep pelvic nodes.

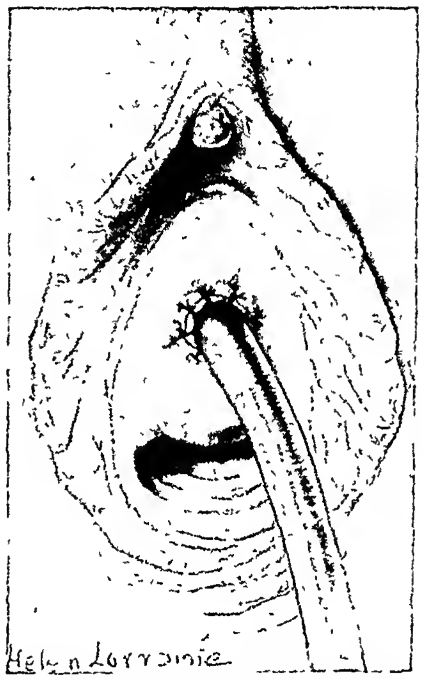

Fig 542—The completed operation An indwelling catheter is left for forty-eight hours

The symptoms are not characteristic and unfortunately the growth is often advanced before a physician is consulted. Bleeding and disturbances of urination do not occur until ulceration or partial obstruction has occurred.

On examination a papillary growth may be seen protruding from the urethral meatus or an indurated mass may be felt extending along the urethra. The meatus may be thickened and smooth or ulcerated. Differentiation must be made from benign tumors or urethral prolapse Tumors of the vulva which have involved the urethra can be differentiated by the extensive involvement of the vulva. An accurate diagnosis is made by the examination of a biopsy specimen.

Treatment that has been advocated consists of surgical excision, irradiation by x-ray or radium, electrodesiccation or a combination of these methods. Excision of the tumor is the treatment of choice, if there is a probability of remov-

ing the growth completely The anterior portion of the urethra may be extirpated within 1 cm of the neck of the bladder without disturbing the sphincteric action

Excision of the urethra is begun by surrounding the meatus with an incision 1 cm or more from the palpable margin of the disease The urethral meatus is thus detached with the diseased tissue from the vestibule The dissection is then carried up under the symphysis, keeping close to the pubic rami and carrying the dissection below the urethra on both sides The growth is retracted forward and the dissection continued back to the healthy portion of the urethra The urethra is amputated well behind the posterior margin of the disease The tissues of the vaginal wall are divided on both sides of the urethra and the tumor mass is removed The stump of the urethra is sutured to the adjacent vaginal mucous membrane Bleeding is controlled by ligation or by suturing the bleeding area with catgut It is probably better to do this dissection with a high frequency cutting electrode and control bleeding areas by fulguration In some cases it is possible to mobilize flaps from the vagina to cover a portion of the raw surface that is left The remaining area should be protected by a petrolatum jelly gauze dressing until granulations appear A catheter should be left in the bladder a week or ten days for drainage and comfort If the growth is so extensive that the entire urethra must be removed provision must be made to divert the urine Incontinence is sure to result and if there is a probability that the local growth has been entirely excised, ureterocutaneous or ureterointestinal anastomosis will be more satisfactory Dissection of the inguinal areas is indicated if there is evidence of metastasis Radical dissection of the inguinal nodes is not necessary in every operable case Metastasis does not always occur early and it is better to keep the patient under close observation and remove the nodes only when they are believed to be involved

Vincent O'Conor has reported good results following destruction of the diseased portion of the urethra with electrodesiccation The bipolar current is used with high amperage and low voltage With a flat electrode the involved area is completely coagulated An indwelling catheter is maintained for about a week ' The urethra must be dilated for several months to prevent stricture

In advanced cases radium or x rays may be used with the hope of retarding the growth Radium is applied by well secured packs placed in the vagina beneath the urethra or radium needles or emanations may be embedded in the tissues A few apparent cures have been reported from the use of radium Considerable discomfort may follow this method of treatment and it is necessary to dilate the urethra for several months to prevent stricture

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CHAPTER XXXVII

SURGICAL CONDITIONS OF THE PENIS AND THEIR TREATMENT

Phimosis, Redundant Prepuce, Injuries, Carcinoma Circumcision Plastic Operations Amputation

CIRCUMCISION

Circumcision may be done under local anesthesia If on an infant, the adhesions that are often found between the glans penis and the prepuce should be well separated By cutting down the prepuce without separating these adhesions anteriorly, the meatus may be split and the glans injured, which will be followed by considerable bleeding The prepuce is grasped anteriorly on each side of the midline by two small hemostats Slight traction is made and if there is any reason to expect adhesions between the glans and the prepuce a pair of curved scissors is inserted within the prepuce and gently spread so as to separate the adhesions sufficiently to make a dorsal incision in the prepuce without injuring the glans A straight incision is then carried down the dorsum of the prepuce to a point about opposite the corona (Fig 543) This point must be determined before too much traction is made upon the prepuce, as otherwise the incision may be carried too far Any further adhesions are now thoroughly separated and the prepuce is trimmed from the upper extremity of this dorsal incision around to the frenum on each side parallel with the corona Sufficient tissue should be left at the frenum to allow for suturing without contraction The bleeding points are caught with mosquito forceps and tied with fine catgut The wound is closed with a continuous suture of fine chromic catgut which begins on the right of the frenum, is carried around the incision and terminates a short distance from its beginning (Fig 544) This leaves a slight interval between the beginning and the end of the suture which allows for swelling or erection If the tissues of the frenum are not satisfactorily covered by this suture one or two interrupted sutures of fine chromic catgut are placed

A method in use at the out patient department of the Medical College of Virginia is, we think, preferable for beginners and when no assistance is available With the penis lying naturally, with no tension on the prepuce an incision is made with a sharp knife following the prominence of the corona (Fig 545) The prepuce is then retracted and a similar incision is made in the mucous membrane about one quarter of an inch behind the corona, except at the frenum where a little more margin is allowed The skin and mucous membrane beyond the two incisions are cut away with scissors (Fig 546) hemostasis is secured, and the wound is closed as previously described (Fig 547) This method assures smooth incisions which fit together accurately and there is no danger of removing too much tissue

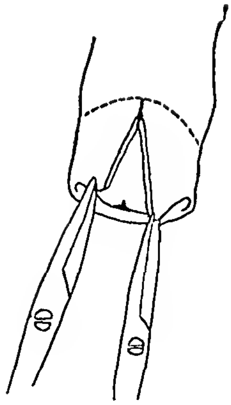

Fig 543

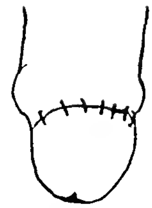

Fig 544.

Fig. 543—The first stage of circumcision The dorsal incision is made and the dotted line shows the incision for removal of the prepuce, which should be just distal to the corona

Fig 544—The circumcision is completed

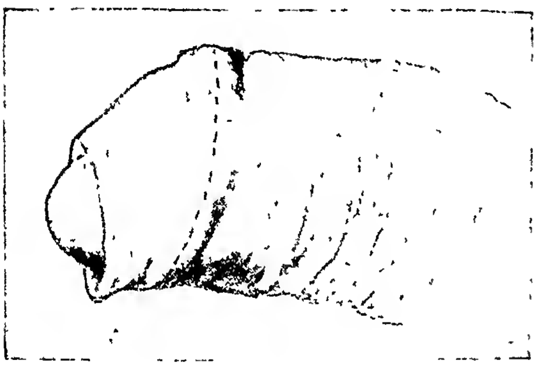

Fig 545

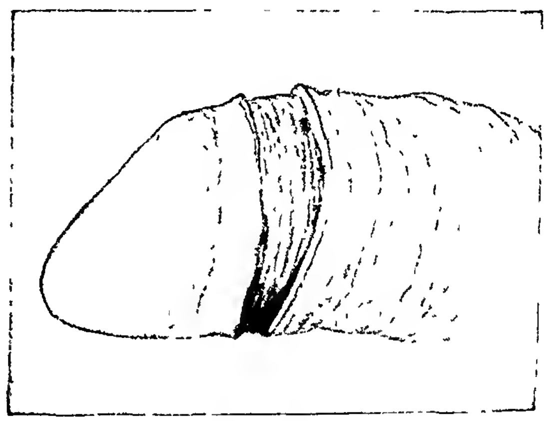

Fig 546

Fig 545.—An incision is made with a sharp knife through the skin and superficial fascia over the prominence of the corona After the incision in the skin has been made, the prepuce is retracted and a similar incision is made through the mucous membrane about one-fourth inch behind the corona

Fig 546—In this illustration both incisions have been made and the intervening tissue excised

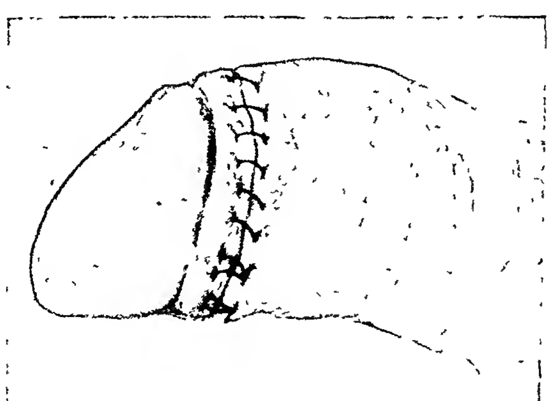

Fig 547—After ligating the bleeding vessels, the wound is closed with a continuous suture of fine chromic catgut It is a good idea to use two sutures, leaving a short intervening space which prevents constriction in case of swelling

Fig 548

Fig 549

Fig 548—Operation to restore the skin of the penis The penis has been completely denuded

Fig 549—Incisions are made at the top and bottom of the anterior surface of the scrotum the intervening skin is dissected up and the penis pulled beneath the flap A few interrupted sutures are taken from the scrotum to the margin of the torn prepuce

Fig 550

Fig 551

Fig 550—Photograph taken about thirty days following first operation The skin graft was then cut from the scrotum and sutured together over the ventral surface of the penis

Fig 551—Final result

INJURIES OF THE PENIS

Injuries of the penis consist of incised, lacerated, and punctured wounds and contusions. Superficial injuries heal readily and are of little consequence.

When the urethra or fibrous sheath of the corpora cavernosa is cut or torn, serious results may ensue from extravasation of urine, excessive hemorrhage, and the eventual deformity of the penis.

Treatment.—The wound should be cleansed, devitalized tissue excised, and an effort made to secure primary union by stopping all bleeding and accurately suturing the divided tissue If the urethra is injured, it should be splinted by an indwelling catheter which also serves to divert the urine from the injured area

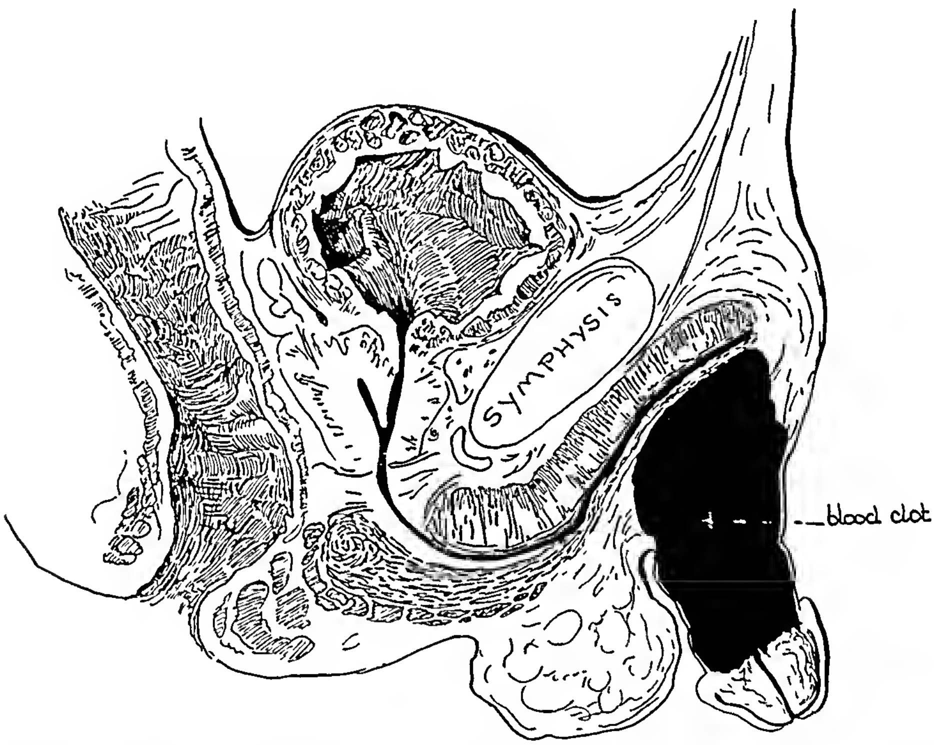

Fig 552—Diagram of dislocation of the penis The patient was run over by a truck and the penis crushed against the pubic bone, tearing the corpora and urethra from the glans and dislocating them beneath the pubis

Contused wounds frequently cause large hematomas due to the laxity of the skin and the abundant blood supply. This is particularly true when the sheath of the corpora cavernosa is torn Bleeding may often be controlled by pressure, but if excessive, the tissues should be incised and the bleeding points ligated. The corpus spongiosum is occasionally fractured when erect or indurated with inflammatory exudates and the urethra is included in the injury. Stricture of the urethra often follows such injuries The penis should be splinted and hot dressings applied. If acute infection is present, catheterization is contraindicated unless retention of urine occurs.

Injury of the penis resulting in gangrene may result from the application of a ligature or a ring around the organ. Treatment consists in removing the constricting object and in antiseptic care of the penis until the slough has

separated. Skin grafting or plastic operations may be indicated. When the penis is extensively denuded (Fig. 548) a whole thickness skin graft from the scrotum is the most satisfactory method of repairing the defect. Two transverse incisions are made on the anterior surface of the scrotum, one at the penoscrotal junction and the other near the bottom of the scrotum. The scrotal skin between these incisions is dissected from the underlying fascia. The penis is then pulled beneath this scrotal graft and the edges of the graft are sutured to the margins of the remaining skin of the penis at the base of the penis and just behind the corona (Fig. 549). In three or four weeks the graft is completely excised from the scrotum and the operation is completed by suturing the lateral margins of the graft together over the ventral surface of the penis. The wound in the scrotum is closed by a continuous mattress suture (Figs. 550 and 551). If the urethra is involved it is often necessary to divert the urine until the penis has healed. A split thickness skin graft from the inner surface of the thighs is also useful in replacing extensive loss of skin from the penis.

Dislocation of the penis is the result of injury in which the skin is violently pulled upon. The skin becomes detached from the penis, the mucous membrane of the prepuce is torn from its attachment behind the corona or at the preputial orifice, and the penis is thrust into the subcutaneous tissue of the abdomen, scrotum, groin or thigh.

A child treated by me had been run over by a light truck, the body of the penis including the urethra was torn from the glans and forced under the skin of the pubis. The skin was distended with clotted blood (Fig. 552). An incision was made on the ventral surface of the skin, the clot was removed, and the penis was brought down and sutured to the glans with interrupted sutures of plain catgut. A catheter was placed in the urethra to serve as a splint and divert the urine. About half of the glans penis sloughed away because of injury to the blood supply, otherwise healing occurred satisfactorily.

CARCINOMA OF THE PENIS

Carcinoma of the penis is not frequently encountered. It is said to represent from 1 to 3 per cent of all cancers in the male (Ewing). Lewis found carcinoma of the penis to represent 3.5 per cent of 2017 patients with malignant disease who were admitted to the Brady Urological Institute during a period of fifteen years. Pack and Lefevre found that one hundred patients with epithelioma of the penis admitted to the Memorial Hospital in New York represented 2 per cent of all tumors of the genitourinary system and 1.25 per cent of all malignant tumors of the male admitted during the same period.

Carcinoma of the penis has been reported in every decade of life from the third to the ninth. The average age at onset is approximately fifty years with the largest percentage occurring in the fifth and sixth decades. Although the disease occurs in all walks of life, most of the cases reported are from the lower strata of society. There is little doubt that individuals in this group are not so careful of their personal hygiene. Chronic irritation seems to be a definite

causative factor. In the one hundred and twenty cases reported by Dean, at least 65 per cent had some mechanical difficulty in retracting the prepuce and chronic irritation beneath the prepuce was a common complaint. No cases of cancer of the penis have been reported in men who were circumcised during infancy. Circumcision later in life does not confer complete immunity. Occasionally cancer occurs in an old circumcision scar or the wound does not heal following circumcision. Such cases probably represent early carcinomatous lesions at the time of circumcision. Syphilis is frequently mentioned as a probable predisposing cause. Dean found that of seventy patients in his group 34 per cent had active syphilis at the time, or had been treated for syphilis. The first evidence of cancer in the syphilitic patients occurred at an average of 43 years of age while the average of the nonsyphilitic patients was 51 years. He concluded that syphilis increased susceptibility to the exciting causes of cancer.

Pathological Characteristics.—There are two varieties of carcinomas of the penis: the flat, indurated tumors usually characterized by a crater-like ulceration surrounded by an indurated margin, and the fungating or cauliflower growth which often begins as an apparently benign papillary structure or small wart. As the papillary tumors progress, the surrounding tissues become indurated, portions of the fungus-like structure slough off, and ulcers are formed. Histologically, both are squamous cell carcinomas. The flat variety is encountered a little more frequently and probably metastasizes earlier, but there is no difference in the rate of growth of the two.

Cancers of the penis usually begin on or near the corona of the glans, or on the adjacent portion of the prepuce. The flat tumors infiltrate and excavate rather deeply beyond the margins of the ulcer The papillary tumors do not infiltrate so deeply at first, but are very destructive to the surface skin, often growing directly through the prepuce, then gradually destroying the entire cutaneous surface of the penis.

Metastasis is not an early feature of cancer of the penis. Of the one hundred twenty patients in Dean's series, adenopathy was noted in 76 per cent with only half of these cancerous. Of 34 patients reported by Lewis, the duration of symptoms before operation averaged 26 months, and metastasis had occurred in only thirteen. Extension is first to the superficial inguinal and femoral nodes, later to the retroperitoneal nodes and to distant portions of the body. Metastasis occurs by embolism except in the later stages when direct extension may occur.

Diagnosis.—Carcinoma of the pénis should always be considered whenever a chronic sore of the penis is encountered. The only positive way of making an early diagnosis is to examine a biopsy specimen from all such ulcers. Chancres are recognized by the history, parchment-like base, and positive dark-field or serological test. Chancroids grow rapidly, are very painful, and are often accompanied by inflammatory adenopathy. When these ulcers resist treatment for several weeks, biopsies are advisable. All other ulcers should be examined immediately. Indurated areas beneath the prepuce, the appearance of warts beneath the prepuce, or scaly patches that bleed on erection are often early

carcinomatous lesions, and a section of tissue should be examined microscopically The age of the patient is of little help The diagnosis is easy in large ulcerating or fungating lesions with extensive induration of the adjacent tissues, but the prognosis is correspondingly poor

The presence of metastasis is difficult to determine The majority of patients have palpable inguinal nodes, but cancer cells will be found in less than half of them Palpable lymph nodes are not unusual in the inguinal areas of healthy men Furthermore, most cancers of the penis are infected, with extension of the infection to the inguinal nodes Hard shotty nodes or nodes fixed to the surrounding tissues are characteristic of malignancy, but there is a considerable margin of error when depending upon palpation alone A more positive method is the excision or aspiration biopsy A positive diagnosis of metastasis is not necessary if it is the surgeon's custom to dissect the nodes from the inguinal areas in all cases

Treatment.—Practically all cancers of the penis are radioresistant and very heavy doses of x ray or radium are required for their removal For this reason all except small superficial cancers should be treated by amputation of the penis at least 2.5 cm from the proximal extension of the growth and removal of the nodes of the inguinal and femoral areas in suitable cases

Only the smallest and most superficial lesions are suitable for treatment with radiation Dean reports 75 per cent cures in superficial lesions of not more than 2 cm in diameter A dose of 1400 millicurie hours per square millimeter was given, using a radon plaque with a filter of 2 mm of brass The superficial ulcer remaining after the growth has disappeared is dressed daily with petroleum jelly gauze Radium should not be used when there is any probability that the cavernous tissues are involved, regardless of the size of the growth

Surgical treatment gives the best hope of successfully eradicating cancer of the penis This is especially true when the disease has extended well beneath the integument H H Young has demonstrated that in most cases the entire superficial lymphatic drainage from a penile carcinoma can be removed in continuity with the cancer, leaving a stump of penis sufficiently long for functional purposes The amputation of the penis should be made at least 2 cm from any palpable thickening of the growth The stump of the urethra should be left a little longer than the stump of the corpora cavernosa There is probably some advantage in doing the amputation with the high frequency current, for bleeding is controlled to some extent by this method and there is less danger of disseminating the cancer cells When sufficient stump cannot be left to permit voiding without soiling the scrotum, a complete amputation should be done and a urethral orifice constructed in the perineum Transplantation of the urethra to the scrotum rarely gives a satisfactory result

The probability of metastasis to the nodes of the groins must be recognized *in all cases and they should be removed* except in elderly or debilitated patients, or when the primary tumor is superficial and of short duration There is unquestionable advantage in a complete block dissection, *removing the nodes from* the inguinal and femoral areas in one mass with the penile cancer, when the

age and physical condition of the patient will permit. The disadvantages of such a radical procedure will outweigh the advantages for elderly patients or those in poor physical condition, especially when there is considerable infection complicating the cancer. The shock of a long and tedious operation, the sloughing of skin flaps deprived of adequate blood supply and the infection that follows dissection of an inflamed area combine to provide a rather stormy convalescence for the patient in poor physical condition. In such cases a more conservative operation gives a much better prospect of immediate recovery with a reasonable chance of permanent cure. When there is considerable risk or when the inguinal nodes show definite evidence of infection, the operation may be done in two stages, amputating the penis at the first operation and dissecting the inguinal and femoral nodes at a later date. It is well to recall that the majority of cures recorded in cancer of the penis are in patients in whom no malignant cells could be found in the nodes removed or in whom biopsy of nodes was negative. Permanent recoveries in cases of proved metastasis are relatively few. Therefore, extensive dissections in patients who are poor risks are not justified When the lesion is early or the patient is a poor risk and there are no palpable nodes in the groin, it is entirely justifiable to do a conservative amputation of the penis and keep the patient under observation for the possible occurrence of metastasis. It is quite probable that no further treatment will be necessary. The practice of dissecting the inguinal areas only in those cases in which metastasis can be proved by biopsy is questionable because of the probability of overlooking early metastasis.

Surgical Technique.—Operations for carcinoma of the penis should vary according to the extent of the growth and the age and physical condition of the patient. It is unnecessary to remove an extensive portion of the penis when the cancer is limited to the distal portion. A margin of 2 cm. posterior to the proximal limit of the growth ensures freedom from recurrence in the stump. It must be remembered, however, that if the stump is so short that it retracts beneath the skin of the scrotum, the maintenance of personal hygiene will be more difficult than if the entire penis is removed and the urethral orifice established in the perineum. The method of dealing with the inguinal nodes must also vary with different patients. The procedure proposed by H H. Young which is designed to remove the primary growth, the regional lymph nodes and the intervening lymphatics in one block gives the best prospects of cure and should be recommended when the patient is relatively young and in good general health. In more elderly or infirm patients it is often better to be a little less radical even at the expense of less probability of a final cure. In these cases we prefer the operation devised by Roger C Graves, done in one or two stages, depending upon the condition of the patient.

Regardless of the operation to be used, a period of preliminary preparation is helpful in many cases. This should be directed toward reducing the infection in the primary growth, cleansing the skin of the groins and genitals, and general improvement in the patient's health by a properly regulated diet and transfusions of blood when indicated Spinal anesthesia should be used unless there

is some definite contraindication The blood pressure may be maintained during the operation by the continuous intravenous administration of 5 per cent dextrose in Ringer's solution If the patient is anemic, the administration of a blood transfusion during the operation serves the double purpose of preventing shock and relieving the anemia

Young's Operation—With the patient in the recumbent position the region of the tumor is covered with a tightly fitting antiseptic dressing, and the skin of the lower abdomen and the upper portion of the thighs and genitals is thoroughly disinfected A semilunar incision is made, curving toward the pubis from a point near the anterior superior spine on one side to a similar point on the other The lower part of this incision is just above the base of the penis From the most dependent portion of this incision two parallel longitudinal incisions are made one on each side of the shaft of the penis about 2 cm apart

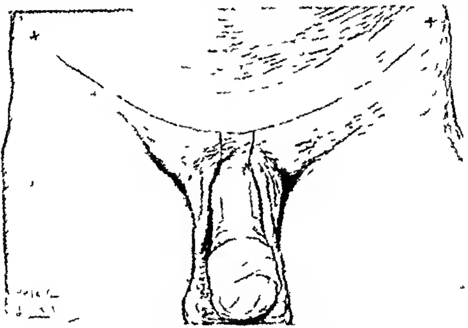

Fig 553—Young's operation for radical amputation of the penis Outline of incisions

down to the point at which the penis is to be amputated These incisions are then joined by a circular incision on the ventral surface of the penis The skin across the dorsal surface is not divided (Fig 553) The incisions along and around the penis extend only through the skin Beginning at the upper angles of the groins, the skin is elevated and the fat and nodes are dissected cleanly from the deep fascia from above downward This dissection exposes the inguinal canals, the external rings, and the fascial coverings of the spermatic cords The dissection is continued below Poupart's ligament, removing fat and nodes near the femoral vessels The fat which accompanies the spermatic cords is removed for a short distance down the scrotal sac During this part of the operation much time is saved if the assistant dissects on one side while the operator dissects on the other When the dissection is complete, the fat and lymph nodes removed in one mass remain attached only at the base of the penis

The flap of skin which has been outlined on the lateral and ventral surfaces of the penis is now dissected back, exposing Buck's fascia which covers the corpus spongiosum and cavernosum. Buck's fascia is then incised longitudinally along the under surface of the corpus spongiosum and dissected up from the penis on both sides back to the suspensory ligament where it is divided transversely (Fig. 554). The corpus spongiosum is then divided obliquely and the corpus cavernosum transversely about 1.5 cm. further back. The re-

Fig 554—Fascia and fat containing inguinal and femoral lymph nodes completely removed, including strip of skin and fascia from the dorsum of the penis The penis is amputated and removed with the mass of fat and lymph nodes. The wound is closed and the stump of the penis covered by the skin of the lateral and ventral surfaces which have been preserved.

maining bands of fascia at the base of the penis are now divided and the primary lesion, the regional lymph nodes with their supporting fatty tissue, and the intervening lymph channels are removed in one mass. The ends of the corpora cavernosa are brought together with mattress sutures of No. 0 chromic catgut which thoroughly control the hemorrhage. The skin is now drawn over the stump and is sutured with interrupted sutures of coarse silk or cotton.

The urethra which projects beyond the corpora cavernosa is sutured to the skin at the lower margin of the stump Both groins are drained by cigarette drains which are brought out through stab wounds in the lower skin flap and the skin incision of the abdomen is closed with interrupted nonabsorbable sutures As originally described, Young's operation did not include the removal of Buck's fascia This feature added in recent years probably adds very little to the value of the operation

When the operation is complete, a catheter is tied in the urethra a few days for drainage of the bladder and a very snug dressing is applied to the suprapubic area and groins to obliterate dead space and encourage healing

Roger C Graves Operation—In the operative technique devised by Graves no effort is made to remove the involved tissues in continuity A conservative or radical amputation of the penis is done, depending upon the extent of the cancer, and the regional lymph nodes are removed at the same time or at a later operation by two curved incisions designed to expose the nodes probably involved without extensive undermining of skin margins (Fig 557) There is less immediate shock to the patient and less probability of sloughing and suppuration of the wound Inasmuch as most cancers metastasize embolically along the lymph channels there is probably very little disadvantage in dividing the intervening lymphatics between the penis and the groin and in the more hazardous cases there is a decided advantage in the immediate prospects of recovery

Conservative (Partial) Amputation of the Penis—The most important requirements in partial amputation are that an adequate length of healthy tissue be removed with the cancer to insure against recurrence in the stump and that the urethra be left a little longer than the corpora cavernosa to permit satisfactory urination and prevent stenosis of the meatus After applying a tourniquet at the base of the penis, an incision is made through the skin completely around the penis and about 2 cm from the apparent border of the disease The skin after being incised is retracted back and the dorsal vein and artery are exposed, ligated and divided The corpora cavernosa are divided *transversely* and the corpus spongiosum and urethra are divided about 1 cm *in front of the* stump of the corpora cavernosa The ends of the corpora cavernosa are closed with interrupted sutures of No 0 chromic catgut, each suture passing from the margin of Buck's fascia on one side of the stump to an opposite point on the other (Fig 555) Each suture should take a bite *in the septum* between the corpora In this way bleeding is entirely *controlled The urethra* is split a short distance and each flap is sutured to the adjacent skin margin of the stump Above the urethra the skin is *sutured over the* ends of the corpora cavernosa with interrupted sutures of coarse silk or cotton (Fig 556) The wound may be protected by a liberal *application* of compound tincture of benzoin No dressing is required If a liberal portion of the penis has been left, a retained catheter is unnecessary

Complete Amputation—The following method advocated by Graves is the most satisfactory method of removing the entire penis A vertical midline suprapubic incision is made extending from the base of the penis far enough upward

so that the scrotum will be pulled away from the perineum when its upper portion is sutured to the apex of the wound at the close of the operation. The lower end of the incision encircles the penis and penetrates to the investing fascia of the corpora cavernosa and spongiosum (Fig 557). The fat beneath the suprapubic incision, lying between the medial aspects of the spermatic cords and around the base of the penis, is dissected away down to the deep fascia to be

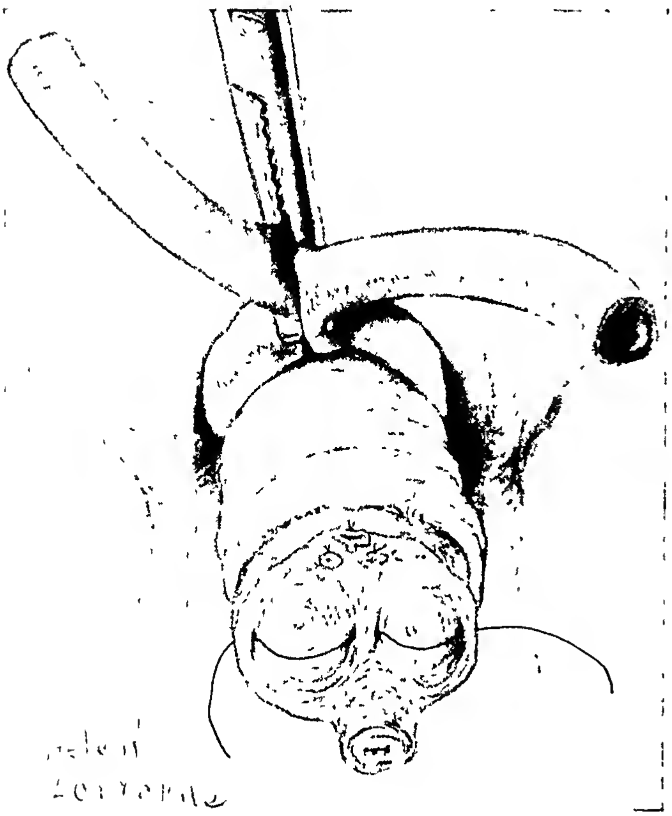

Fig 555

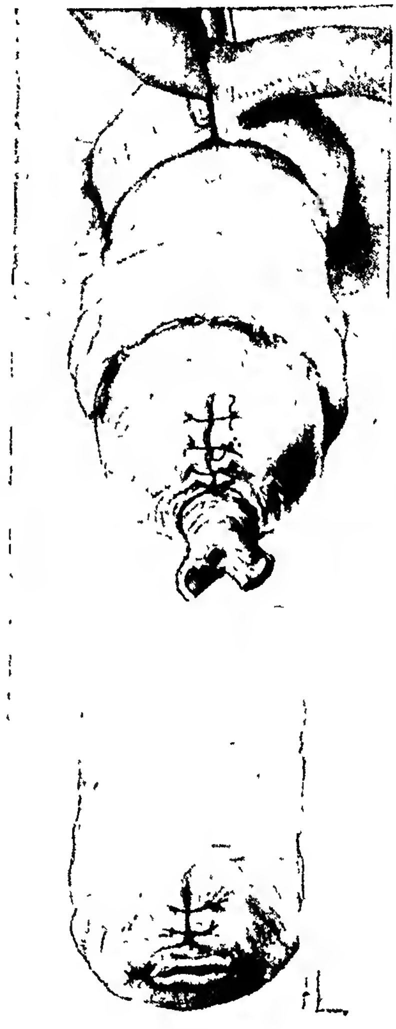

Fig 556

Fig 555—Roger Graves' technique of partial amputation of the penis The corpora spongiosum and urethra are left a little longer than the corpora cavernosa. After ligating the dorsal vessels, interrupted sutures of No 1 chromic catgut are taken through the dense fascial coverings of the corpora

Fig 556—Roger Graves' operation continued Upper drawing shows closure of fascia over corpora cavernosa and end of urethra split Lower drawing shows skin drawn over the stump and sutured to the urethra

removed with the penis (Fig 558). The corpus spongiosum and urethra are now cut across, preferably with a high-frequency knife, well proximal to the diseased process, leaving sufficient length of urethra to be transplanted without tension into the perineum. The corpus spongiosum is now dissected away from the corpora cavernosa from the point of division downward and backward until it can be brought through a stab wound in the perineum between the anus and

base of the scrotum without angulation or tension (Fig 559) The scrotal tissues are easily separated from the penis by blunt finger dissection and division of the scrotum is not necessary Some care is taken in separating the corpus spongiosum from the corpora cavernosa There is no ready line of cleavage until the region of the bulb is approached Sharp dissection is necessary and the urethra may be injured This dissection is aided by passing a soft bougie or catheter into the urethra When the urethra has been completely freed from the corpora cavernosa, it is brought directly through a stab wound in the perineum and fixed to the skin by subcuticular sutures of fine chromic catgut, one on each side and one posteriorly The redundant portion of the urethra is excised about 1 cm from the skin and a small rubber tissue drain is brought through a stab wound just anterior to the urethra The corpora cavernosa are

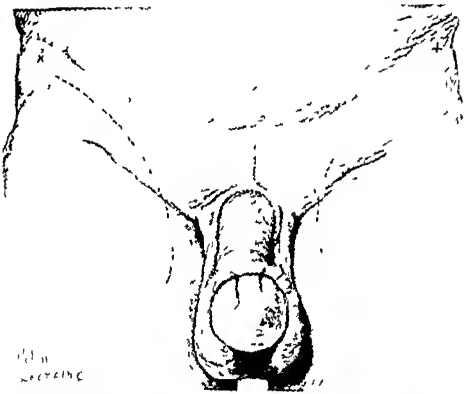

Fig 5 —Roger Graves operation for radical treatment of cancer of the penis Dotted lines indicate incisions for removing the lymph nodes and amputating the penis

dissected free by first dividing the suspensory ligament and ligating and dividing the dorsal artery and vein at the base of the penis The dissection is now continued toward the roots of the penis, keeping close to the investing fascia When the roots of the cavernous bodies are reached, the bulbous urethra is protected by a wooden spatula covered with moist gauze while the cavernous bodies are amputated near their attachments with a mildly coagulating current (Fig 560) The exposed ends of the stumps are closed over with continuous sutures of No 1 plain catgut It is not necessary to remove the corpora down to their attachments to the ischiopubic rami The upper portion of the scrotum is now sutured to the margins of the suprapubic wound by two rows of sutures, sub

(Text continued on page 69?)

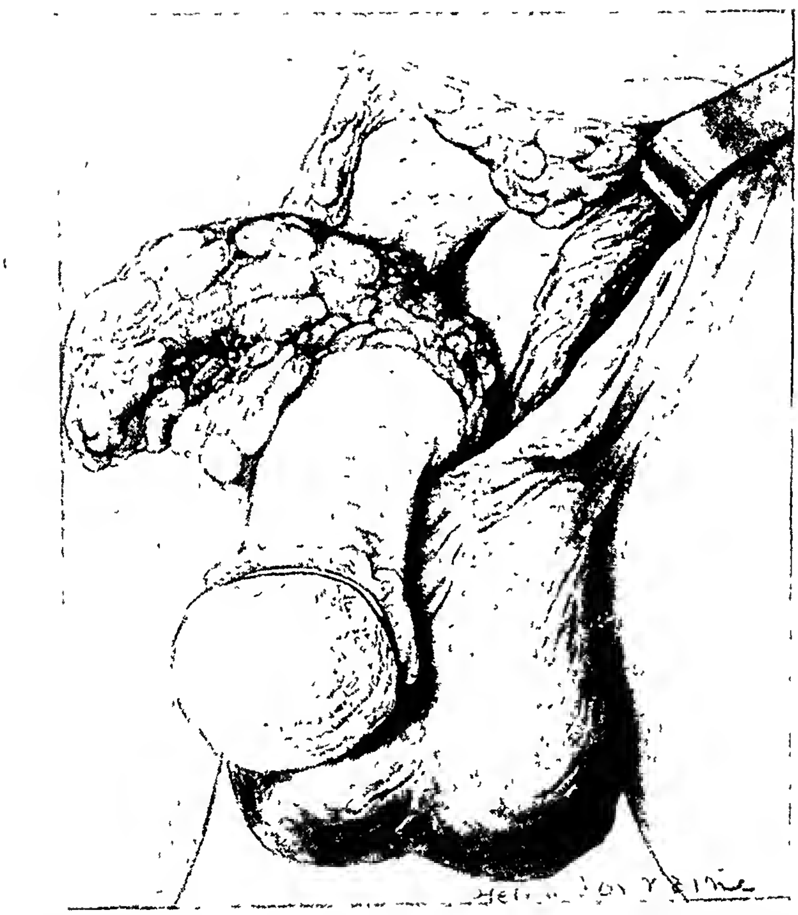

Fig 558—Roger Graves' operation continued Fat and fascia dissected from the pubic area and suspensory ligament divided freeing the penis from attachments to the pubis.

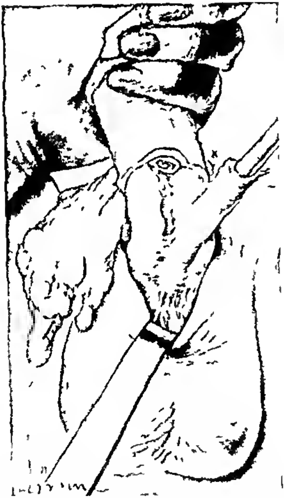

Fig 559 —Roger Graves operation continued The urethra is divided an inch or more from the margin of the cancer and dissected from the corpora cavernosa

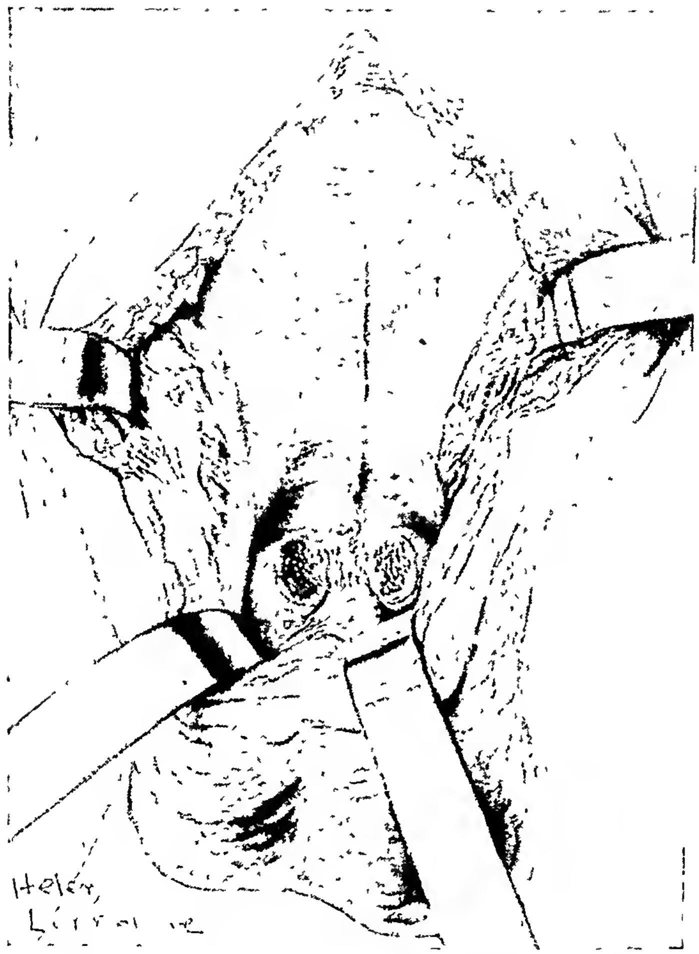

Fig 560—Roger Graves' operation continued The wound is retracted and the corpora cavernosa divided as they join to form the penis

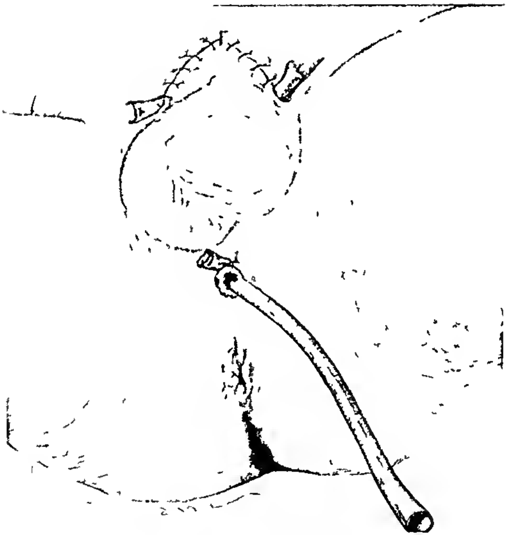

Fig 561 —Roger Graves operation continued The urethra has been brought out through a stab wound in the perineum and the scrotum is sutured to the margins of the pubic incision

cuticular sutures of plain catgut in the fat and fascia, and coarse silk or cotton in the skin. The first suture approximates the raphe of the scrotum to the upper angle of the suprapubic wound. Small wicks of rubber-covered gauze are placed in the lower angles of the wound for temporary drainage (Fig. 566). A small soft catheter is passed to the bladder and fastened to the upper portion of the thigh with adhesive for drainage during the first few days. A gauze pad is placed against the perineum in front of the urethra and is held firmly in position by a perineal binder. This elevates the scrotum and obliterates the newly opened space back of the scrotum.

BLOCK DISSECTION OF INGUINAL AND FEMORAL AREAS

The inguinal glands may be dissected, following either the conservative or radical amputation, at the same time or later, depending upon the judgment of the operator. The extent of the dissection should be determined by the nature of the lesion and the physical condition of the patient. Since the superficial glands communicate efferently with the deep inguinal and external iliac nodes, the dissection should be as complete as circumstances will permit The dissection described may be terminated at any stage. It is applicable to gland dissection necessary because of lesions of the lower extremities, the gluteal and anal regions, and external genitalia of the male or the female Dissections because of lesions of the anal area or external genitalia should always be bilateral. Each incision begins medial to the anterior superior spine of the ilium and extends parallel to and a little above Poupart's ligament to within one fingerbreadth of the pubic spine where it curves downward and outward across the area of the femoral triangle. More adequate exposure is afforded than when a simple oblique incision is used, and the poorly healing corners of a T-shaped wound are avoided. Beginning at the upper angles of the wounds, the skin is elevated and the fat glands and fascia are dissected cleanly from the muscles or their aponeurosis from above downward. This dissection exposes the inguinal ligaments, the external rings, and the fascial coverings of the spermatic cords. The fat which accompanies the spermatic cords is removed for a short distance down the scrotal sac. The dissection is continued below the Poupart's ligament, removing fat, fascia and glands superficial to the femoral vessels The saphenous artery and vein are ligated above and below the mass of tissue to be removed The underlying femoral vessels and the muscles of the thigh in the femoral triangle are exposed. During this part of the operation much time is saved if the assistant dissects on one side while the operator dissects on the other.

The second step in the dissection consists of removing the femoral sheath with its contained adipose tissue and glands from the femoral vessels throughout the extent of the femoral triangle. The surrounding fibrous and adipose tissue should be removed from the femoral vessels, their circumflex and deep branches, and the femoral nerve. When necessary, small ramifying vessels may be ligated and divided to facilitate the dissection.

The third and final stage of the dissection consists of removing lymph glands, areolar tissue and fat located along the iliac vessels. The iliac nodes are exposed by incising the aponeurosis of the external oblique muscle from the external ring to a point just above the internal ring. The external oblique fascia and transversalis muscle are incised lateral to the spermatic cord exposing the properitoneal fat. All fat and fascia are dissected from the spermatic cord and it is retracted medially. The inguinal ligament and adjoining fascia are divided over the femoral vessels, thereby permitting easy access to areolar and glandular tissue in this area. The parietal peritoneum is then liberated and retracted upward and medially, exposing the iliac vessels from the point of bifurcation downward. It is usually necessary to ligate and divide the inferior epigastric vessels to obtain adequate exposure. All fat, fascia and lymph nodes are cleanly removed from the bifurcation of the common iliac vessels downward, including glands situated around the obturator in the operative field. After all bleeding has been carefully controlled the inguinal ligament is united over the femoral vessels and the inguinal canal reconstructed over the spermatic cord. Penrose drains are placed at both angles of the wound and the skin incision is closed carefully. A pressure dressing is applied.

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CHAPTER XXXVIII

SURGICAL CONDITIONS OF THE SCROTUM AND THEIR TREATMENT

Wounds; Infections, Acute and Chronic; Idiopathic Gangrene; Elephantiasis; Carcinoma; Plastic Operations; Resection of Scrotum

The scrotum is subject to the usual surgical diseases that affect the skin elsewhere and is also often involved in injuries and disease processes of the testicles, spermatic cords and urethra. In addition to incisions for the exposure of the testicles and spermatic cords, operations upon the scrotum may be required for the treatment of wounds, the drainage of suppurative processes, the excision of malignant tumors, and for the plastic correction of elephantiasis, and extensive destruction of the scrotum because of injury or disease

Preparation of the Patient.—The general preparations, such as restriction of food and the administration of preoperative medication, are the same as that for operations on other genitourinary organs and vary according to the condition of the patient, the method of anesthesia, and the extent of the operation to be done (Chapter III).

The local preparation is of considerable importance. The skin of the scrotum is probably more constantly subjected to sources of infection than any other area of the body, yet its texture is such that vigorous scrubbing or the application of strong disinfecting preparations is quite irritating The external genitals and groins should be shaved and thoroughly washed with green soap and water, preferably at least twelve hours before the operation. Before the patient leaves the ward for the operating room, the washing with green soap and water should be repeated and the area covered with a sterile dressing.

After the patient is anesthetized, the dressing is removed and the operative areas sponged off with 70 per cent alcohol to be followed by 10 per cent Merthiolate or tincture of Metaphen Iodine is quite irritating to the scrotum. The area to be involved in the operation should be carefully isolated by sterile sheets and towels

Anesthesia.—Unless there is some contraindication, spinal anesthesia is very satisfactory. The dose administered need not be large for operations in this area, and almost any operation may be completed before the effects of the anesthetic wear off. Inhalation anesthesia is usually necessary in children. Avertin and ethylene or nitrous oxide oxygen are quite satisfactory. In minor operations and in operations upon the aged and greatly debilitated, local anesthesia may be preferred. Intravenous anesthesia is useful when the operation can be completed within a short time.

WOUNDS OF THE SCROTUM

Wounds of the scrotum are rarely severe and are not often encountered in civil life. They consist of contusions, lacerations, gunshot wounds, cuts, and

stab wounds Because of the vascularity and loose structure of the scrotum, extensive ecchymosis, rather large hematomas, or considerable bleeding may occur Injury of the scrotum may be accompanied by injury or displacement of the testicles The more severe injuries result from malicious assault, attempted emasculation, or industrial accidents In such cases the scrotum may be extensively lacerated or torn away almost entirely

Treatment—In mild degrees of contusion with ecchymosis or small hematomas, relief is obtained by palliative measures A well fitting suspensory to afford support and partial immobilization will often be sufficient When there are swelling and pain, the patient should be put to bed, the scrotum elevated and cold compresses or ice bags applied When the acute symptoms have subsided, heat may be applied to hasten absorption If there is a large hematoma, the scrotum should be incised, the blood evacuated, and the bleeding vessels located and ligated In the absence of infection the wound may be closed without drainage The hematoma is usually found in the loose areolar tissue between the dartos layer and the fibrous coverings of the testicle

In penetrating wounds hematoma may be complicated by hematocele, in which event the hematoma may be confined chiefly to the fibrous coverings of the testicle, although if the injury is extensive the entire scrotum may be filled with blood When a hematocele is recognized, the tunica vaginalis should be opened, any injury of the testicle or epididymis repaired, and bleeding areas ligated

Hematoma is not an infrequent complication of operations upon the contents of the scrotum If the surgeon is not careful to ligate every bleeding area, or if considerable blunt dissection is done within the scrotum, small blood vessels overlooked or temporarily occluded by trauma may bleed for a long time after the wound is closed Delayed bleeding may also be caused by the use of Adrenalin in the solution used for local anesthesia in operations on the scrotum or its contents Postoperative bleeding can be avoided by sharp dissection and extreme care in ligating all bleeding areas If secondary bleeding is at all extensive, much time in convalescence is saved by opening the wound, evacuating the blood clots, and ligating the bleeding points

In lacerated or incised wounds, bleeding may be quite profuse and the wound is usually soiled The wound should be flushed out with an antiseptic solution, such as freshly prepared 2 per cent Mercurochrome or tincture of Merthiolate All foreign material should be removed, the devitalized tissue excised and bleeding points carefully ligated If there is injury to the scrotal contents or to the urethra, this should be treated at the same operation Sulfanilamide is then dusted into the wound and the wound is closed with a small rubber tissue drain in the lower angle Because of the elasticity of the scrotum, accurate closure can usually be done even when extensive portions have been torn away When there is very little scrotum left, closure may be accomplished by freeing the skin bordering the scrotum laterally and toward the perineum for a distance of one or two inches or if the loss of tissue is too extensive for this, Howard s operation for reconstruction of the scrotum (Figs 564 567) may be

done. The scrotum will regenerate even when the testicles are entirely denuded, but much time is saved by plastic operations when there is extensive loss of tissue.

SUPPURATIVE PROCESSES

Inflammation and suppuration of the scrotum are usually secondary to inflammatory diseases of the epididymis, testis or urethra. More rarely inflammatory processes may involve the scrotum primarily. Abscesses secondary to disease of the epididymis and testis may be chronic or acute. The chronic abscesses are usually caused by tuberculosis The scrotal skin first becomes adherent to the underlying inflammatory process. This is followed by an area of fluctuation over which the skin is smooth and glistening. Eventually the abscess ruptures and a sinus is formed When such abscesses are discovered early, the treatment is epididymectomy, excising the involved scrotum with the epididymis. In late cases with a large fluctuant area it is probably better to excise the thinned area of skin and curet the cavity, according to the method practiced by Keyes for the treatment of suppurative tuberculous epididymitis (page 558).

Acute suppurative processes of the epididymis or testicle may rupture into the scrotum. The rupture is recognized by rapid increase in the size of the scrotum accompanied by edema and an increase in pain and tenderness. There is also a rather sharp rise in temperature and frequently a chill. The treatment is wide incision over the lower part of the scrotum and adequate drainage. Usually much of the loose areolar tissue and sometimes areas of the skin become gangrenous and slough away. If the testicle is involved, it may also slough off and is extruded through the scrotal wound. If the wound is kept clean by antiseptic irrigations and the patient is given supportive treatment according to his needs, a healthy granulating cavity is formed and healing soon occurs. Often the more resistant fibrous tissue of the testicle contracts together with the tunic, and a nodule resembling an atrophied testicle remains. The patient is better satisfied than if an orchiectomy had been done.

Periurethral phlegmon resulting from inflammatory stricture and extravasations of blood and urine following injury of the urethra may invade the scrotum. The infection or extravasated urine first invades the loose areolar space beneath the dartos layer. Suppuration and gangrene occur rapidly and extensively. In neglected cases the subcutaneous fascia and fat of the abdomen may be invaded even as high as the axilla. Early and free incisions with adequate drainage are indicated. Plastic operations may be required later to reconstruct the scrotum. This condition is also discussed under diseases and injuries of the urethra.

IDIOPATHIC GANGRENE OF SCROTUM

Idiopathic gangrene of the scrotum is an acute fulminating inflammatory process involving the scrotum and penis. The onset is spontaneous, with marked edema and hyperemia, followed rapidly by necrosis of the superficial tissues.

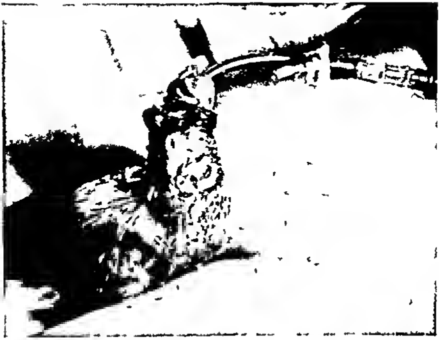

Fig 562 —Gangrene of the scrotum (H H Howard's case)

Fig 563 —Skin and fascia of the scrotum have sloughed away exposing the testicles (H H Howard's case)

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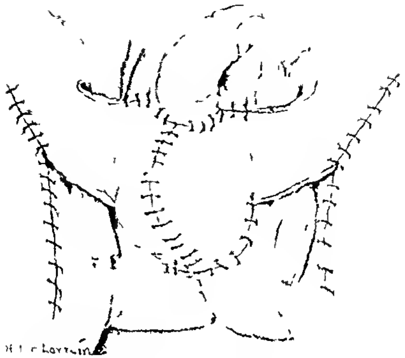

Fig 566—Howard's operation continued The skin margins of the denuded areas on thigh are sutured together

Fig 567—Howard's operation continued After about three weeks the operation is completed by dividing the pedicles of the skin flaps

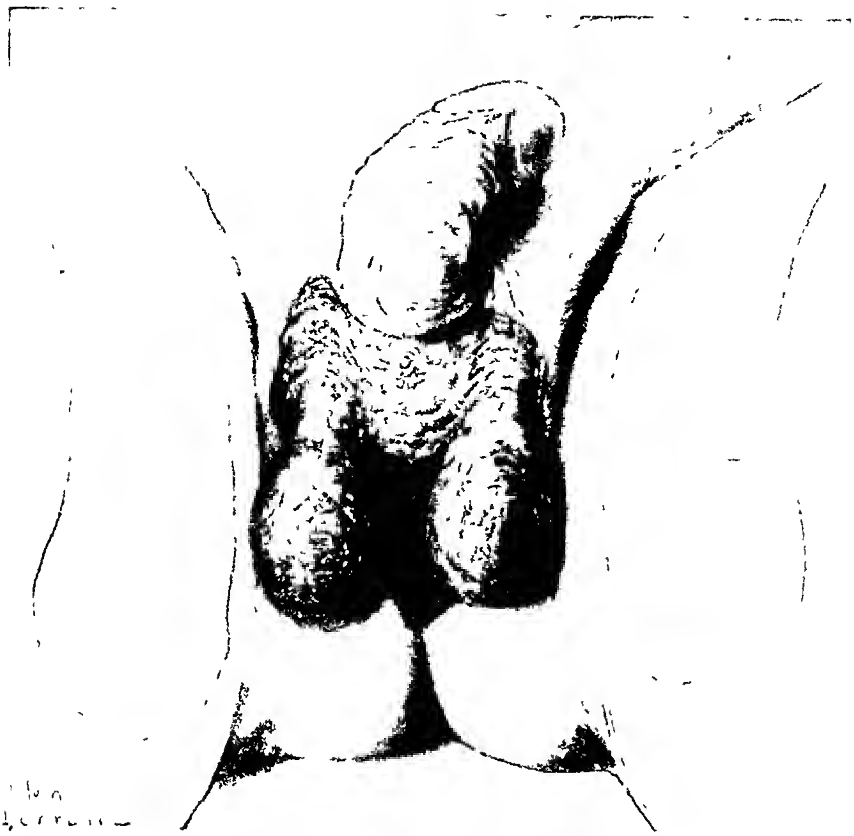

Fig 564 —Outline of skin flaps for construction of new scrotum Operation devised by H H Howard.

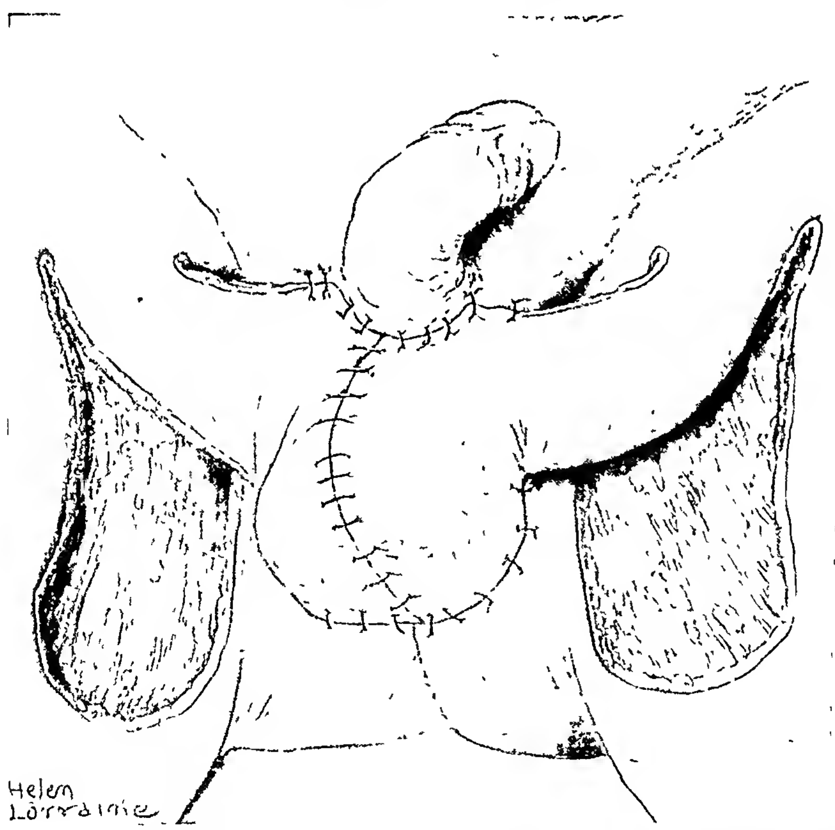

Fig 565 —Howard's operation, continued Skin flaps from inner surfaces of thighs are dissected up and sutured together over the testicles Adequate blood supply is provided through the broad pedicles at upper end of the grafts

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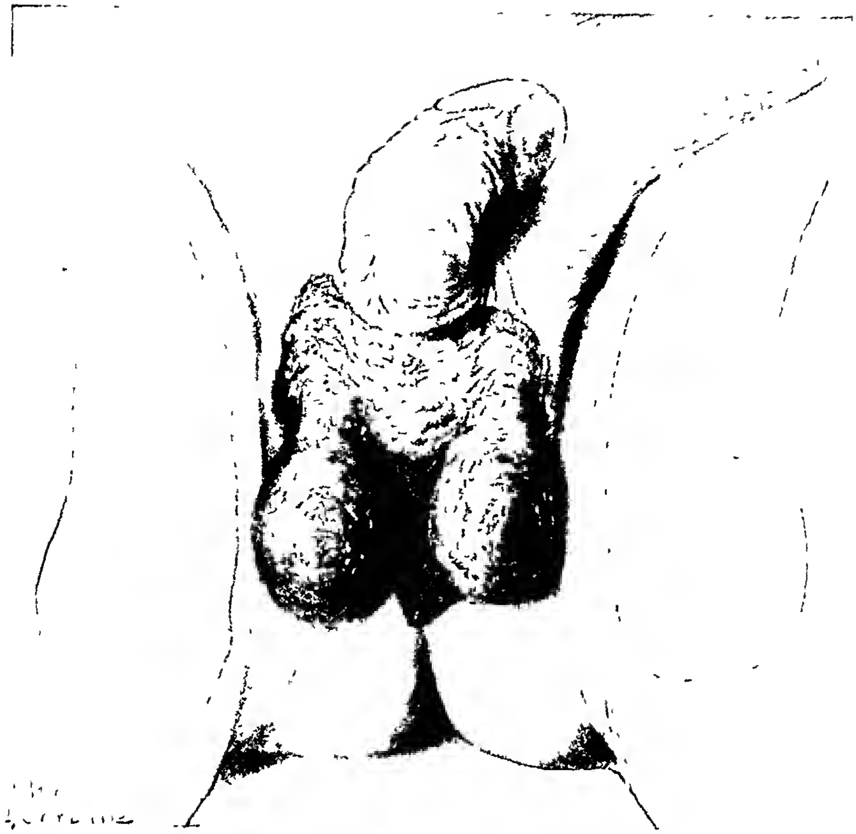

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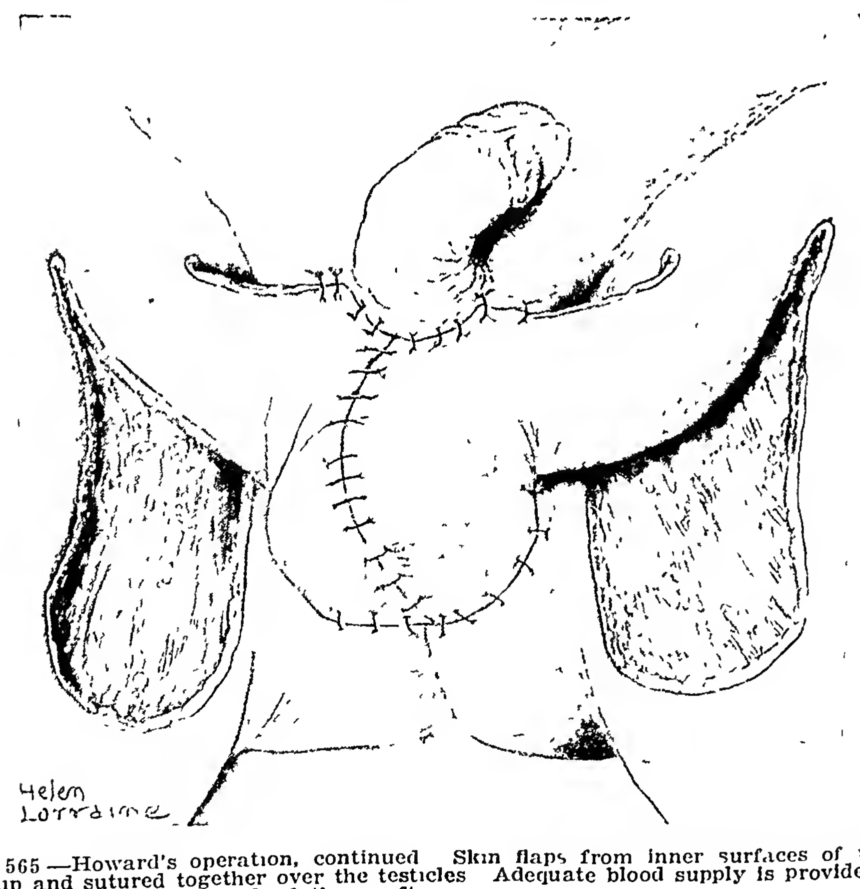

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The patient reported by Howard suffered complete loss of the scrotum, the sloughing area extended from the base of the penis to the anus posteriorly and laterally to the thighs At the end of twenty eight days there was little evidence that the scrotum would regenerate A plastic operation was done Two large pedicle flaps were freed from the inner surface of the thighs, with their bases just below the inguinal line, thus ensuring a good blood supply (Fig 564) These flaps were so formed that when turned over the testicles, they completely covered them, forming a sac (Fig 565) The edges were approximated by silk worm gut stay sutures, reinforced by skin clips The sac was drained with rubber tissue The denuded areas left by the formation of the flaps were completely closed at this time because the skin was loose from the loss of weight by the patient Two gauze drains were placed under each pedicle (Fig 566) and a snug dry sterile dressing was applied A Foley self retaining catheter was inserted to aid in maintaining cleanliness at the operative site

There was no operative sepsis and the circulation was very good The pedicles were severed separately and the newly formed sac rapidly assumed the appearance of a normal scrotum (Fig 567)

Howard advises that a scrotal support be worn for at least three months following this operation to prevent excessive sagging

ELEPHANTIASIS

Extensive enlargement and thickening of the scrotum may result from obstruction of the lymph channels (Fig 568) The most striking example of this condition is from infestation with a nematode known as *Filaria sanguinis hominis* The disease is native in certain tropical countries and most patients seen here have contracted the disease elsewhere Sufficient enlargement of the scrotum to cause considerable inconvenience may be caused by lymphatic blockage by chronic inflammatory disease or by radical dissection of the inguinal areas

Edema and hyperplasia of the skin and connective tissue appear The skin surface is coarse and pits very slightly on pressure On the upper portion of the lateral surfaces of the scrotum the skin is more nearly normal, and in plastic operations for improvement of the condition, skin flaps can be outlined in these areas to cover the testicles when the redundant tissue has been removed In advanced cases the penis may be encased in the scrotal mass with only a slit leading to the meatus through which urine is voided In less advanced cases the penis may remain distinct with considerable edema and thickening of its skin

Operation—For a few days before operation the scrotum should be elevated, frequently cleansed, and an effort made to heal any macerated or ulcerating areas The scrotum is prepared locally as previously described (page 694) and the patient is anesthetized Two flaps are outlined for reconstruction of the scrotum, one on each side and near the upper portion of the scrotum The incision begins just below the external inguinal ring and courses downward, curving slightly toward the midline and then downward and backward, to meet a similar incision from the opposite side at the raphe, near the base of the

The patient is usually extremely ill with fever, chills, toxemia and marked prostration. The condition closely resembles inflammation and gangrene of the scrotum resulting from periurethral phlegmon or extravasation of urine. The perineum, however, is not involved and there are no urinary symptoms (Fig. 562). The inflammatory process usually remains confined to the superficial tissues of the penis and scrotum. Extension to the abdomen is uncommon. The cause is probably neglect of personal hygiene. It may occur at any age. The fine texture and loose construction of the scrotal skin afford ready access to bacteria by scratching or through macerated areas. Many different bacteria, both aerobic and anaerobic, have been described. The one most constantly found is the *Streptococcus hemolyticus*. The treatment is surgical drainage by early and free incisions. The incisions should be made preferably with a high-frequency electrode or cautery, all gangrenous or necrotic areas of skin should be excised, and a wet dressing of 1 to 1000 permanganate of potash applied Systemic treatment consists of sulfonamides or antibiotics and of supportive treatment, such as adequate nourishment. and intravenous fluids and transfusions when indicated.

After a few days a line of demarcation forms and the gangrenous tissue begins to slough away, leaving a clean granulating surface. The testicles may be partly or completely exposed. The testicles are first covered by granulation tissue (Fig. 563) and later by a fairly normal-looking scrotum. During the process of healing, the testicles should be held in normal position with dressings. Convalescence is often greatly hastened by plastic operations to close the defect in the scrotum or to reconstruct the scrotum by transplanting skin from the thighs (Figs 564-567).

PLASTIC OPERATIONS UPON THE SCROTUM

Plastic operations upon the scrotum are done to cover the testicles when a large portion of the scrotum has been destroyed by injury or disease, and to resect redundant tissue and reconstruct the scrotum in cases of elephantiasis

The scrotum is very elastic and when a portion has been destroyed the testicles can often be covered by simply freshening the skin margins and suturing them together. In more extensive cases it is necessary to dissect the skin surrounding the scrotum free, as suggested by Browne and Smith, or to transfer flaps from the thighs, as advocated by Herbert H. Howard.

Browne and Smith report a case in which the scrotum sloughed away because of idiopathic gangrene. When the testicles had become covered with healthy granulations the scrotal margin for about one centimeter was dissected free and the skin of the perineum, thighs and groins was undermined until the scrotal edges could be brought together without undue tension over the testicles. The cords, which were fixed by adhesions where they disappeared beneath the skin above, were freed so that complete mobility was obtained Button mattress sutures were placed to relieve the tension on the midline sutures The wound was closed without drainage. Recovery was uneventful, and much time was saved in the convalescence.

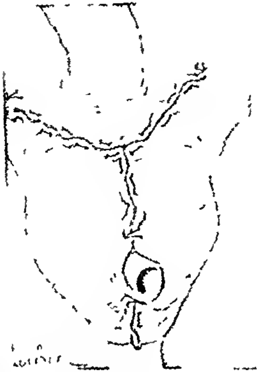

Fig 570—Scrotum has been excised and the wound closed with continuous mattress suture of coarse silk

Fig 571—Condition thirty days following operation for elephantiasis of the scrotum see Fig 566

Fig 568 —Elephantiasis of the scrotum Cause undetermined

Fig 569 —Outline of incision for excision of large, edematous scrotum

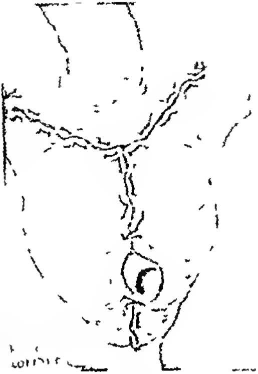

Fig 570 — Scrotum has been excised and the wound closed with continuous mattress suture of coarse silk

Fig 571 — Condition thirty days following operation for elephantiasis of the scrotum See Fig 565

scrotum posteriorly. On the anterior portion of the scrotum these incisions are connected by incisions that begin at the upper end of the incisions and pass downward and to the midline to meet just beneath the base of the penis (Fig. 569). If the penis is retracted within the scrotum, these upper incisions pass straight across, meeting at the base of the penis anteriorly. An incision is then made in the midline over the penis down to the slit through which urine is passed and surrounds this opening, thereby isolating an area of skin with which to cover the penis when the redundant tissue is excised.

The skin flaps that have been outlined on each side are then dissected from the scrotal mass and the bleeding is controlled. The skin flaps are covered with warm moist sheets while the redundant tissue is removed. The spermatic cords and testicles are isolated by carefully dissecting through the edematous tissue on each side near the upper portion of the mass. The edematous tissue is dissected away until the tunica vaginalis and spermatic cords are exposed. These are held out of the way and the entire mass of hypertrophied tissue is excised. All bleeding vessels are clamped and ligated. The penis previously enclosed in the scrotum is covered by the skin isolated by the circular incision. If this skin is insufficient or so diseased that an extensive portion must be excised, skin grafts may be applied. If the penis is not seriously involved and there is a redundant edematous prepuce, circumcision should be done. The skin flaps previously outlined are sutured over the testicles with interrupted sutures of silkworm gut or coarse silk. A rubber tissue drain is placed within the newly-formed scrotum and brought out at the most dependent portion of the incision (Figs. 570 and 571). A snug dressing is applied.

CARCINOMA OF THE SCROTUM

Carcinoma of the scrotum is a rare disease in this country. Many cases were at one time reported among chimney sweeps in England. It is most frequently seen now among those who work in tar and paraffin, and occasionally in those employed in dye works The disease is similar to carcinoma of the skin elsewhere The growth is slow and metastases are relatively late.

The treatment consists of radical excision of the scrotum with plastic repair of the defect. In advanced, neglected cases involvement of the testicles may require partial or complete emasculation. If the disease is at all extensive, the inguinal glands should be resected.

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CHAPTER XXXIX

SURGICAL CONDITIONS OF THE TUNICA VAGINALIS AND SPERMATIC CORD AND THEIR TREATMENT

Hydrocele of the Tunica Vaginalis, Hydroceles and Cysts of the Spermatic Cord, Tumors of the Spermatic Cord, Torsion of the Spermatic Cord, Varicocele

HYDROCELE

The accumulation of fluid in the tunica vaginalis accompanying disease of the testicle or epididymis is of very little surgical interest. The condition is usually acute and the fluid is absorbed as the inflammation subsides. Occasionally the fluid accumulates quite rapidly and the tension in the tunic adds considerably to the patient's discomfort. Often relief is afforded by tapping the hydrocele. Tumors or syphilis of the testicle and tuberculosis of the epididymis or testicle are at times accompanied by small hydroceles. The fluid may mask the disease process which is recognized when the fluid is drawn off.

Most chronic hydroceles are classified as idiopathic, though chronic trauma, operation for the cure of varicocele and repeated mild attacks of epididymitis are among the probable causes. In many cases the epididymis is definitely thickened. The testicle usually appears normal when the hydrocele is small. When there is a large accumulation of fluid with a greatly thickened sac the testicle is atrophied, rather soft, and often flattened against the wall of the sac. Patients usually seek relief because of the inconvenience or unsightliness of the enlargement. A very large hydrocele causes a sense of weight and at times a dull pain in the scrotum. The penis becomes invaginated into the mass and in advanced cases there may be excoriation of the scrotum from constant soiling with urine.

Treatment.—The treatment consists of (1) simple tapping and aspiration of the fluid, (2) aspiration of the fluid and the injection of some irritating material to prevent the continued formation of the exudate, and (3) open operation consisting of excision or eversion of the hydrocele sac.

Simple tapping is employed as a palliative measure or as an aid in diagnosis. The severe pain of acute inflammatory conditions of the epididymis or testicle is often ameliorated by aspirating the accompanying acute hydrocele. Some patients object to a more radical procedure and prefer periodic tapping for relief of the weight and deformity of the hydrocele. In feeble elderly men or those with advanced constitutional disease the simplest measure that will afford relief is indicated. The rate of refilling varies greatly. In some cases the sac is quite tense within a month, in others several months may elapse before tapping is again necessary. In children this simple procedure is often curative.

Tapping is rarely indicated or necessary for the diagnosis of hydrocele. The diagnosis should be made by the history and physical findings (Figs 572, 573, 574, and 575). With few exceptions light is transmitted through the mass This together with the evidence on palpation is sufficient to differentiate hydrocele from a solid tumor Hematocele does not transmit light and there is usually a history of trauma.

Hematoceles of long standing may be confused with old thick-walled hydroceles but the treatment is the same. When a small hydrocele accompanies chronic disease of the testicle or epididymitis tapping and aspiration of the fluid permit a more accurate examination.

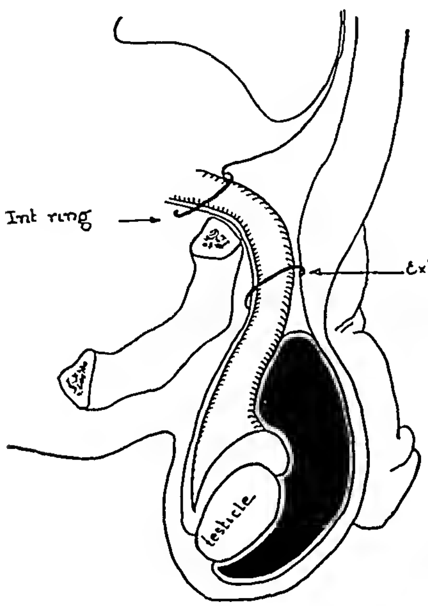

Fig. 572

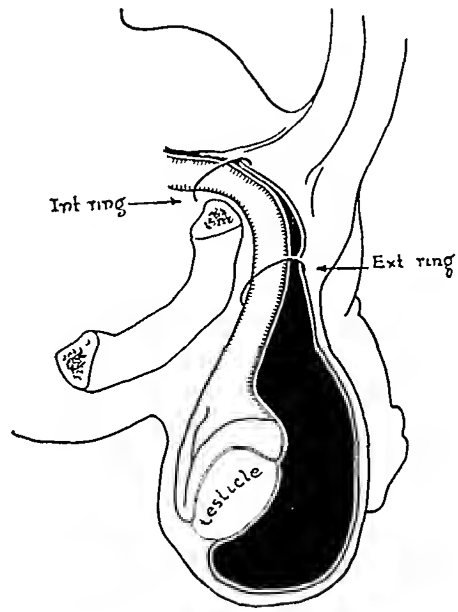

Fig 573

Fig 572—Hydrocele of the tunica vaginalis (Redrawn from Keyes Urology, D Appleton-Century Company, Inc)

Fig 573—Congenital hydrocele (Redrawn from Keyes Urology, D Appleton-Century Company, Inc)

Technique of Tapping.—The scrotum is thoroughly washed with green soap and water and sponged off with 70 per cent alcohol. A large needle or a small trocar should be used. An area on the front and near the lower pole of the mass is selected, care being taken to avoid the blood vessels that course over the scrotum This area may be infiltrated with a local anesthetic. One hand grasps the hydrocele on its posterior surface and holds it steady. The needle or trocar is held in the other hand with the tip of the index finger against the instrument about an inch from the point to prevent it from going too far into the hydrocele. With a quick thrust the point of the instrument is inserted into the cavity, the obturator is removed and the fluid is permitted to run out or is aspirated with a large syringe. When the cavity is empty the needle or trocar is quickly withdrawn, the punctured area is again swabbed with alcohol, allowed to dry and a small collodion dressing is applied. It is very rare that any inconvenience results from tapping a hydrocele. The puncture of a blood vessel in

the scrotal wall is the most frequent accident The small hematoma or ecchymosis that follows is usually readily absorbed The instrument may injure the testicle or tear the opposite wall of the hydrocele if the puncture is not done carefully Hematoceles often result from such injuries The patient should wear a well fitting suspensory a few days following the tapping of a hydrocele

Aspiration and Injection —Hydroceles may often be cured by the simple method of tapping the hydrocele, drawing off the fluid and injecting an irritant The irritant most commonly used is a solution of quinine hydrochloride 13 33 per cent and urethane 6 66 per cent From two to four cubic centimeters are injected according to the size of the hydrocele The injection is almost painless and no inconvenience is apt to result It should not be given in patients known to be sensitive to quinine Pure carbolic acid is also quite effective and in my experience entirely harmless From ten to thirty minims are used, depending upon the size of the hydrocele There is a temporary stinging sensation and

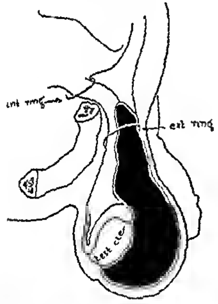

Fig 574

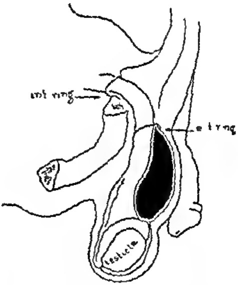

Fig 575

Fig 574 —Infantile hydrocele (Redrawn from Keyes Urology D Appleton Century Company Inc)

Fig 575 —Hydrocele of the spermatic cord (Redrawn from Keyes Urology D Appleton-Century Company Inc)

occasionally transitory pain in the inguinal region All discomfort rapidly subsides because of the anesthetic effect of the phenol With either of these solutions a cure may be effected with one injection, or several may be necessary In my own experience with a few cases of bilateral hydroceles in which quinine and urethane were used on one side and phenol on the other, phenol was more effective

Technique of Injection —The field of operation is prepared and the hydrocele tapped as described under *simple tapping* It is important that all the fluid be aspirated so that the fluid for injection will not be diluted After the hydro

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Hematoceles of long standing may be confused with old thick-walled hydroceles but the treatment is the same. When a small hydrocele accompanies chronic disease of the testicle or epididymitis tapping and aspiration of the fluid permit a more accurate examination.

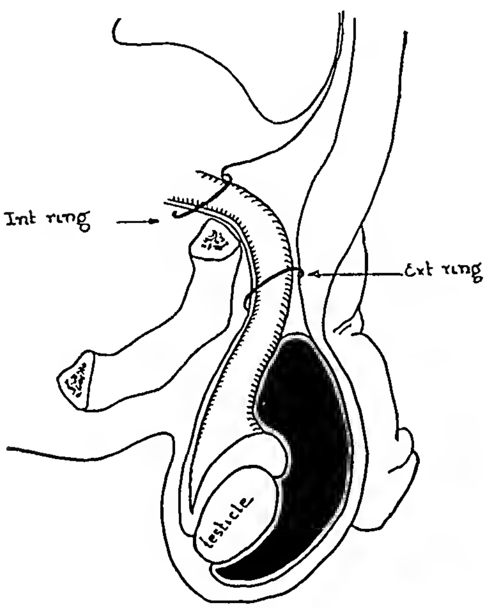

Fig 572

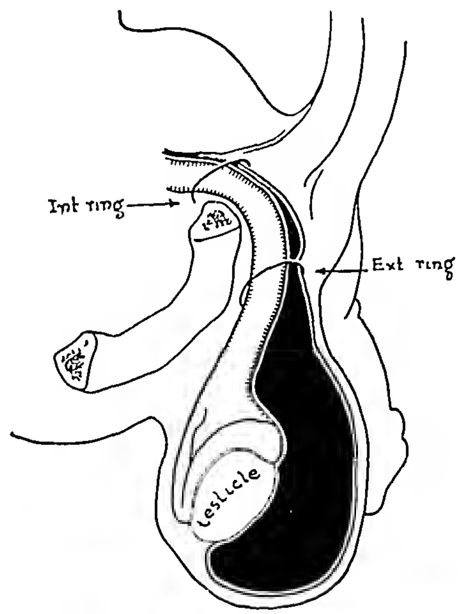

Fig 573

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The treatment has the advantage of permitting the patient to remain ambulatory and usually to continue at work Simple uncomplicated cases with clear fluid and a thin sac wall are readily cured It should not be used for congenital hydroceles, when the sac wall is thickened nor when the fluid is hemorrhagic or purulent, and it is contraindicated in multiple hydroceles and in those accompanying diseases of the epididymis or testis *Epididymo orchitis* occasionally follows the injection treatment This usually responds to palliative treatment, rest in bed, elevation and immobilization of the scrotum and the application of heat

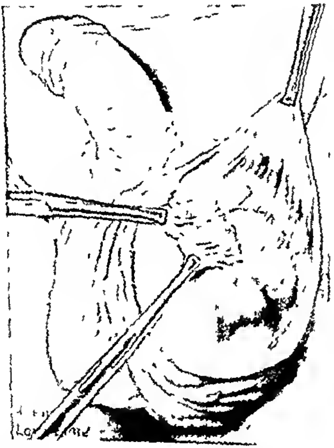

Fig ... —Dividing fascial coverings of the testicle

Open Operations—Open operation is indicated in large hydroceles those containing more than four or five ounces of fluid, particularly when the hydrocele wall is thickened, in congenital hydroceles, in multilocular hydroceles when there is evidence of disease of the epididymis or testis and when the injection treatment has failed

The operation may be done under local or general anesthesia Spinal anesthesia is quite satisfactory and a very small amount of Novocain, usually ... to 75 mg, is sufficient

cele sac appears to be entirely empty, the injection and rapid aspiration of a few cubic centimeters of air will often disclose a small amount of fluid that has been overlooked. It is also important that the tip of the needle or trocar be well within the cavity before the injection is made. If there is any doubt of this the instrument should be removed and the injection done at another time. With the needle in place and the hydrocele empty the aspirating syringe is disconnected and another syringe loaded with the irritant solution is connected to the needle and the solution is slowly injected. The needle is then rapidly withdrawn and the scrotum thoroughly massaged to distribute the solution over the entire surface of the sac. If phenol is used, as the needle is withdrawn a gauze

Fig 576 —Line of incision through median raphe of scrotum for operation upon hydrocele

sponge saturated with alcohol should be applied to the punctured area to absorb and neutralize any of the solution that is spilled. A collodion dressing is applied A well-fitting suspensory should be worn. The patient is instructed to return in one week. Usually a small amount of fluid will have accumulated. If there is sufficient amount to permit tapping with safety the injection is repeated and the patient instructed to return in two weeks. If fluid accumulates after the second injection and is not absorbed within three weeks the treatment is repeated at intervals of three weeks until the hydrocele is cured. Usually two to four injections are sufficient.

The tunica vaginalis is covered by several layers of fascia, and the cremaster muscle over a hydrocele is so thin that it has the appearance of fascia These coverings are carefully divided throughout the length of the hydrocele and are stripped from the tunica vaginalis and testicle leaving in most cases a very thin, almost transparent sac wall (Fig 578) Care should be taken to clamp and ligate every bleeding vessel that can be recognized as the incision through the coverings of the hydrocele is being made In long standing cases with much thickening and induration of the sac wall the investing fascias are one dense layer and cannot be separated from the tunica vaginalis When this is so, the incision is carried through the entire wall of the hydrocele, when it may be possible to find a line of cleavage and strip the endothelial lining of the sac and the testicle from the remainder of the indurated wall Usually in such advanced cases it is more satisfactory to excise the entire indurated wall as close to the testicle as practical and carefully ligate all blood vessels

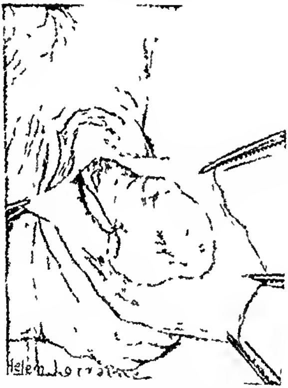

Fig 579.—Bottle operation Tunica vaginalis everted One suture is placed posterior to the cord to hold it in the everted position

When the tunica vaginalis has been exposed and separated from its fascial coverings it may be opened and everted (Andrews's "bottle" operation), partially excised and everted according to the method of Winkelman, or entirely excised

Eversion of the sac, or the so called bottle operation, is done by making an opening near the top of the sac through which the testicle is extruded The sac is then turned inside out and a few sutures are placed to approximate the cut edges of the sac and secure it behind the cord and so prevent reinversion

Several methods of treating the sac have been described. The preliminary steps of all operations are the same. After the area has been properly prepared and draped an incision is made through the scrotum unless the hydrocele is complicated by a hernia. In that case both conditions can be corrected through an inguinal incision. In uncomplicated cases the incision is usually made directly over the enlargement An incision through the raphe is quite satisfactory and has the advantage of avoiding the larger blood vessels and in leaving very little scar (Fig 576). In unilateral hydrocele the raphe is stretched over the enlargement The length of the incision varies with the size of the hydrocele. It should be near the bottom of the scrotum for dependent drainage. When the

Fig 578 — Tunica vaginalis exposed

incision is made through the skin and the closely adherent dartos muscle an area of loose cellular tissue is reached (Fig 577) This tissue loosely connects the inner surface of the scrotum to the coverings of the testicle It is separated from the outer covering of the hydrocele (the columnar fascia) by scissors and blunt dissection on all sides until the hydrocele can be delivered from the scrotum and only remains attached to the scrotum posteriorly. Before delivering the hydrocele heavy gauze sheets should be clipped to the skin margins of the wound to protect the exposed tissues from contact with the surface of the scrotum.

Total excision of the sac is somewhat more tedious and is more apt to be followed by delayed bleeding, but a permanent cure can be expected in all cases in which this is done, since all the parietal layer of the tunica vaginalis is removed. When the tunica vaginalis has been entirely liberated as previously described, it is opened and trimmed away close to the testicle, taking care to leave no redundant fold. All vessels are clamped and tied and areas of oozing are transfixed or closed by continuous sutures of fine plain catgut (Fig 582). When the sac wall is thick and indurated, this is the only satisfactory method of eradicating the hydrocele cavity. When all bleeding is controlled the testicle is returned to the scrotum and fixed in place as previously described. The posterior margin of the testicle and the inner surface of the scrotum posteriorly

Fig 581.—Remainder of tunica vaginalis sutured behind the testicle. Suture through fascia posteriorly to fix testicle in place and prevent torsion of the cord

are sutured. When the hydrocele sac has been satisfactorily disposed of and the testicle returned to the scrotum, the entire operative field should be carefully inspected for the slightest bleeding. In the scrotum insignificant bleeding areas may cause hematomas that will delay healing, or extensive ecchymoses that are quite disturbing to the patient. When bleeding is controlled a small rubber tissue drain is placed to the lower pole of the testicle and brought out at the lower angle of the wound. The fascial coverings of the testicle are closed with a continuous suture of fine plain catgut (Fig 583) and the skin with a continuous mattress suture of 0 chromic catgut which everts the edges of the skin wound and prevents the dartos muscle from pulling it in.

(Fig 579) It is the simplest operative procedure, requiring less dissection, consequently less danger of delayed bleeding and hematoma. Convalescence is short and there is very little discomfort. Recurrence, however, is not uncommon and the operation cannot be used in large hydroceles with thickened sac walls.

Partial excision and eversion of the remainder of the sac wall is a neater operation and recurrence is less apt to occur, particularly when the sac is large. The tunica vaginalis is separated from its investing fascias and is trimmed away to within about half an inch of the testicle (Fig 580). All bleeding points are carefully clamped and ligated and the remaining flaps of the tunica vaginalis

Fig 580 —Partial excision of hydrocele sac, and suture of remaining portion behind the testicle. Redundant tunica vaginalis excised along dotted line.

are sutured behind the testicle with a continuous suture of fine plain catgut. The testicle is then returned to the scrotum and held in place with two or three fine plain catgut sutures to prevent torsion. These sutures are taken through the reflected flaps of the tunic and through the fascial coverings of the testicle so that when they are tied the testicle will assume its normal position in the scrotum (Fig. 581) In this method there is no redundant sac wall left to form pockets for the reaccumulation of fluid and no possibility that the sac will become reinverted.

When the operation is finished the testicle is covered by all the investing tissues except the tunica vaginalis with the exception of those cases in which there is so much thickening and induration of the wall of the hydrocele that a part or all of the investing fascia must be excised with the tunic

HEMATOCELE

Hematocele usually accompanies injuries of the testicle, epididymis or tunica vaginalis When the hematocele follows trauma there is usually ecchymosis of the scrotum and a smooth, tender, globular mass It is compressible

Fig 584—Hematocele caused by metastatic tumor from the small intestine There are numerous metastases over the surface of the tunica vaginalis

and does not transmit light When the hematocele results from tapping a hydrocele there is rapid reaccumulation of fluid in the hydrocele sac which does not transmit light and there is no ecchymosis of the scrotum Chronic hematocele is more difficult to diagnose The mass is smooth, painless and rather hard The spermatic cord is usually enlarged Differentiation from long standing hydrocele frequently is not made until exposed at operation Differentiation from new growth is discussed under tumor of the testicle

Fig 582—Complete excision of hydrocele sac This operation suitable for old, thick-walled hydroceles.

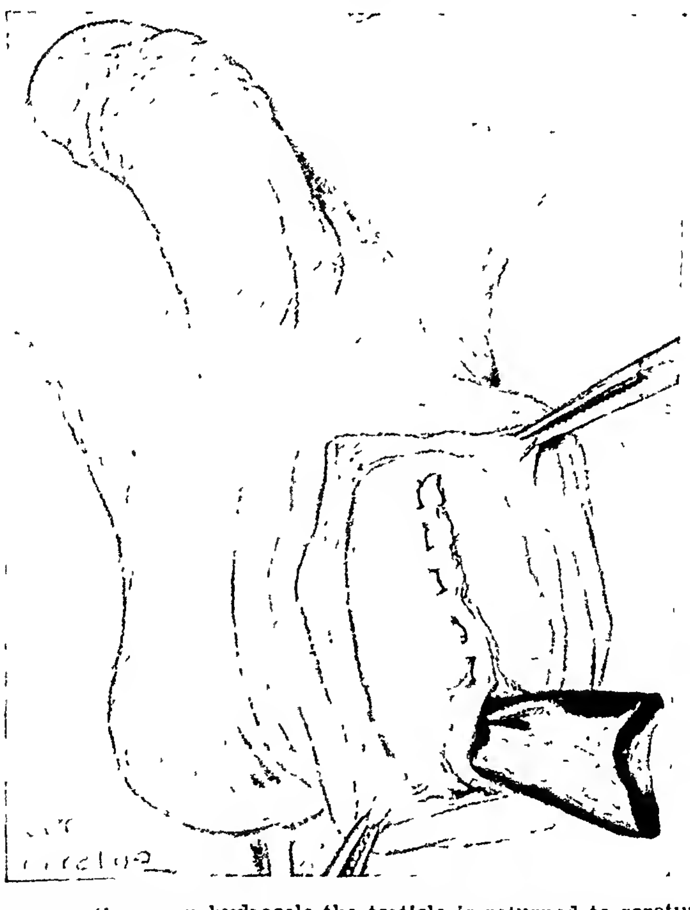

Fig. 583—Following operation upon hydrocele the testicle is returned to scrotum and the wound closed in layers with adequate drainage.

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Hematocele may be caused by extension or metastasis of malignant disease to the tunica vaginalis (Fig. 584).

Treatment.—Operation is the treatment of choice in hematocele. Unless very small they are rarely absorbed. The pressure and irritating effect of the hematocele cause some degree of fibrosis and deterioration of the testicle. In acute cases the tunica vaginalis should be opened, the retained blood removed and any active bleeding controlled. If there is laceration or incision of the testicle the injury should be carefully repaired. The tunica vaginalis is then excised or everted, depending upon its size. In old hematoceles the operation is the same as for hydrocele. The tunica vaginalis is so thick and fibrotic that complete excision is necessary. The testicle is often compressed, fibrotic and of little functional value but should be preserved.

HYDROCELES AND CYSTS OF THE SPERMATIC CORD

Hydrocele of the spermatic cord occurs in an unobliterated portion of the funicular process and is termed encysted hydrocele of the cord (Fig 575). Such hydroceles may be single or multilocular, depending upon whether there is one or more than one unobliterated area in the funicular process They are sausage-shaped and are usually found in the scrotal portion of the cord. They can often be reduced into the inguinal canal and are sometimes mistaken for hernia. Hydroceles of the cord may also be confused with cysts arising from dilatation of persistent tubules of the organ of Giraldes.

There is also described a diffuse type of hydrocele of the cord, consisting of a serous collection of the nature of edema in the cellular tissues of the cord It is most common in children but occasionally is seen in adults.

Hydroceles of the cord can usually be recognized by palpation and transillumination.

Treatment.—When the size of the hydrocele is sufficient to cause discomfort or inconvenience excision is indicated. The spermatic cord is exposed by an incision through the upper part of the scrotum and the cystic mass is carefully dissected out. As usual when operating upon the contents of the scrotum especial care should be taken in ligating all bleeding vessels.

Cysts of the spermatic cord may result from Echinococcus infestation or from fetal remains. The most frequently recognized cyst is the spermatocele probably arising from aberrant tubules of the testicle or epididymis. It occurs in about one per cent of all males. It usually arises between the testicle and epididymis and grows in a direction in which there is no covering of the tunica vaginalis. It occasionally grows into the tunica vaginalis, giving the appearance of a multilocular hydrocele.

When small these cysts do not cause any inconvenience and often go unnoticed. Large cysts are found above one testicle or between the testicles. Occasionally the similarity between shape and size of the testicles leads the patient to believe that he has three testicles. The diagnosis is made by the cystic character and mobility of the mass. The largest cysts are found in men between the ages of 20 and 40 years.

Treatment.—When the cyst is small no treatment is necessary. When it is large enough to cause inconvenience or when the patient is disturbed because of the abnormality the cyst should be excised.

Excision is usually a very simple procedure and can be done in most cases under local anesthesia. The cyst is held against the anterior wall of the scrotum by an assistant while the scrotum and fascial coverings are carefully divided until the surface of the cyst is exposed. Adhesions to the cyst are divided and the mass is easily enucleated. The pedicle which communicates with the testicle or epididymis is ligated with catgut. Bleeding is controlled and the wound closed without drainage.

TUMORS OF THE SPERMATIC CORD

Tumors of the spermatic cord are not encountered very frequently. They arise from the different elements of the cord and at times from remains of the wolffian body. Those most often encountered in the order named are lipomas, sarcomas, mixed tumors (teratomas and dermoids) and fibromas. No authentic case of epithelial tumor has been reported, and proved cases of teratoma are extremely rare. Lipomas and dermoid cysts are usually found in the inguinal canal. Most other tumors are near the lower end of the cord.

Lipomas.—True lipomas of the cord are confined within the coverings of the cord—they must be differentiated from lipomas in the inguinal canal arising in connection with hernias from the preperitoneal fat. In any case the diagnosis is rarely made except at operation. The presence of hernia is usually suspected. J. S. Horsley reported a very interesting tumor removed from the inguinal portion of the spermatic cord. "It was cigar shaped and measured 7 by 2 by 2 cm. It was firm though somewhat elastic and gave on palpation the impression of a solid elastic growth or a very tense cyst (Figs. 585 and 586). The capsule was distinct and considerably congested. On section numerous small cysts were found through the growth. They were about one-third to one-half centimeter in diameter and contained clear fluid. The cystic cavities were clear cut and the walls appeared to be smooth and usually rather thin; there was no evidence of any necrotic material." It was the opinion of Dr. A. C. Broders that the tumor was composed of lipomatous tissue that had been subjected to chronic inflammation.

Fibromas are slow growing tumors arising from the connective tissue elements of the cord. They are usually found near the lower end of the cord. They are smooth and encapsulated and may be mistaken for cysts or for hydrocele of the cord. They may undergo sarcomatous degeneration.

Dermoid cysts are relatively frequent among tumors of the cord and are usually found in the inguinal region.

Sarcomas of various types comprise most of the malignant tumors and are more frequently encountered than any other type of tumor in the lower portion of the cord. They arise in many instances from fibromas.

Diagnosis.—Tumors of the cord do not present any characteristic symptoms. Those arising in the inguinal area are usually dermoids or lipomas and are with rare exceptions benign. They are usually recognized at operation for an accompanying or suspected hernia.

Tumors in the scrotal portion of the cord are often diagnosed as cysts, hydrocele of the cord or spermatocele. The possibility of malignancy should always be borne in mind because of the relative frequency of malignant tumors. A mass that is at all fixed to the cord, testicle or scrotum should arouse suspicion. In doubtful cases the mass should be removed and examined microscopically.

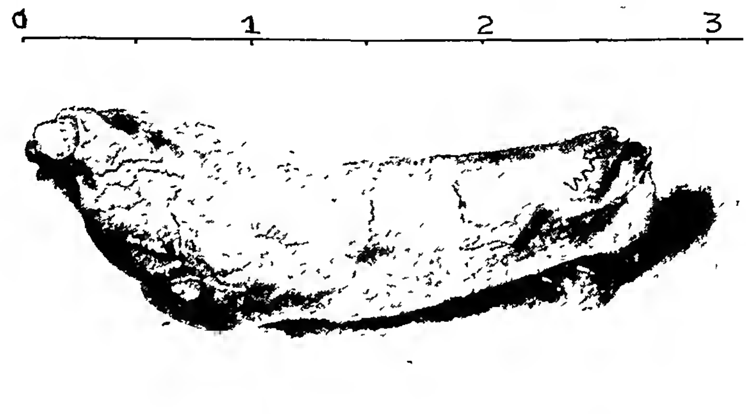

Fig 585—Tumor of the spermatic cord (Horsley Annals of Surgery, January, 1925)

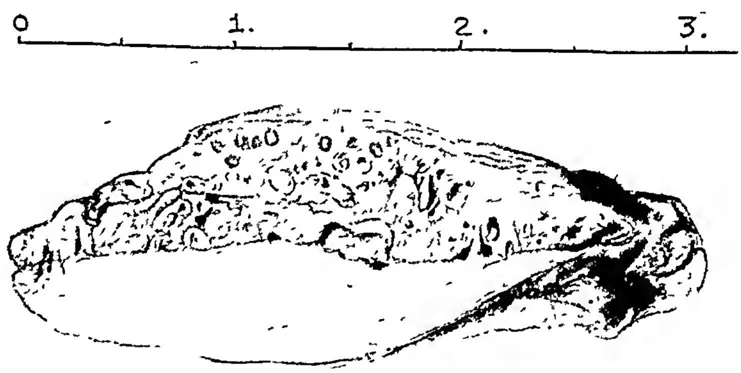

Fig 586—Section of tumor (Fig 585). (Horsley Annals of Surgery, January, 1925)

Treatment.—Treatment for all tumors of the cord is excision. Simple enucleation is satisfactory for benign tumors. When the tumor is malignant there should be the same radical treatment as for tumors of the testicle. It should be remembered that the lymphatic drainage of the cord passes like that of the testicle to the lymph glands near the abdominal aorta.

TORSION OF THE SPERMATIC CORD

Torsion of the spermatic cord, often spoken of as torsion of the testicle, is usually a disease of adolescent boys and young men, though cases have been reported at all ages. Torsion is believed to occur only when there is some con-

genital abnormality Keyes states that torsion is found only in the congenitally ectopic testicle The predisposing causes are a long mesorchium, absence of the mesorchium, a roomy tunica vaginalis with abnormal attachment of the common mesentery and vessels to the testis and globus minor so that the testis is attached by a narrow stalk rather than a broad band There may occur torsion in the undescended as well as in the completely descended testis The immediate cause is usually some violent exercise A patient who came under my observation had a torsion of his right testicle while engaging in athletic activities at camp and two years later the other cord became twisted while practicing with the track team at college Torsion has occurred while the patient was asleep

Fig 587 —Torsion of the spermatic cord

The cord may be twisted from one half to two or more complete turns With rare exceptions the *torsion occurs within the tunica vaginalis* with the direction of the twist toward the midline of the body (Fig 587)

The tunica vaginalis contains a moderate amount of blood tinged fluid Below the twist of the cord the testicle and epididymis are swollen and indurated and vary in color from a purplish red to black, according to the degree of torsion and the time that has elapsed since its occurrence

Diagnosis —Torsion of the undescended testicle is most frequently confused with strangulated hernia The absence of the testicle from the scrotum is the most important differentiating point at first As the case progresses the

pain and shock from torsion will subside, while in strangulated hernia they become worse Furthermore, progressive vomiting and other signs of intestinal obstruction are not found in cases of torsion. When the testicle is in the scrotum, torsion must be differentiated from acute epididymitis or orchitis. The pain in torsion comes on suddenly and is immediately quite severe, often accompanied by nausea and some degree of shock. The involved side of the scrotum rapidly swells and the leg on the affected side is often flexed. There is usually a history of some muscular effort or a sudden movement of the body. After a few hours the pain begins to subside but tenderness persists and the swelling increases. The scrotum becomes red and edematous. In acute inflammation of the epididymis or testicle, the pain and swelling come on more grad-

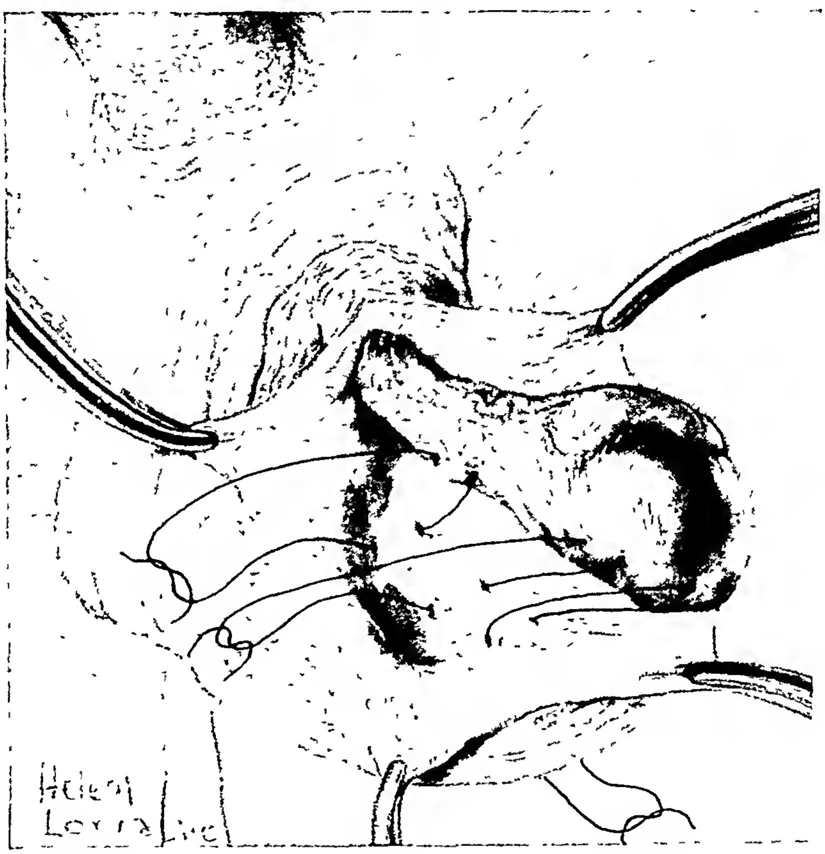

Fig. 588 —Method of fixing loose testicle to the scrotum to prevent torsion of the spermatic cord

ually, and are progressive There is no shock, nausea is rare and there is a history or evidence of urethral infection, recent urethral instrumentation or, more rarely, respiratory infection. Swelling is not so rapid as in torsion and frequently the swollen, tender epididymis can be differentiated from the testicle. When the diagnosis is in doubt the testicle should be explored. Drainage is very good treatment for acute epididymitis and the early correction of a torsion will occasionally save a testicle.

Mild degrees of torsion are occasionally encountered. There is acute pain and sometimes nausea but untwisting takes place spontaneously or is ac-

complished by manipulation of the testicle before swelling has occurred to any extent. Occasionally in recurrent cases the patient learns to untwist the testicle himself. Such cases may be confused with torsion of the hydatid of Morgagni in which the symptoms are similar to those of torsion of the cord though less severe. Most of the cases reported have occurred at a somewhat younger age. The majority have been between 8 and 16 years old. There is very little swelling, the testicle is tender and often the hydatid may be palpated as a pea sized tender body between the head of the epididymis and the upper pole of the testicle.

Treatment.—Operation is indicated in all cases. When the injury is recognized early or when the torsion is of slight degree, the cord should be untwisted and the testicle sutured to the bottom of the scrotum (Fig. 588). Atrophy of the testicle may occur but is rarely complete and some semblance of a testicle is preferred by the patient to none at all. If the torsion has existed several hours and there is no evidence of return of circulation to the epididymis and testicle when the torsion is relieved orchiectomy should be done.

When the torsion has been relieved by external manipulation operation to fix the testicle to the scrotum should be urged. Recurrence is probable and the testicle is apt to be destroyed eventually either by atrophy or by complete strangulation at a subsequent attack.

When operating upon one testicle for torsion the other should be sutured to the scrotum. The predisposing cause of torsion is often bilateral and torsion of both cords occasionally occurs. When there is torsion in an undescended testicle immediate orchiectomy is indicated.

VARICOCELE

Varicose veins of the spermatic cord often occur in adolescent boys and young men. They are most frequently seen by the physician because the patient notices an unnatural condition or because he imagines or fears some disturbance of the sexual function.

At times the patient complains of a heavy dragging sensation or pain in the testicle or cord. Usually reassurance, sexual hygiene and the application of a well fitting suspensory bandage will correct the trouble. In cases with persistent pain or excessive enlargement of the veins with redundant scrotum, operation is indicated. Operation should not be expected to relieve neurotic manifestations, which at times are made worse.

Neuralgia of the testicle may be accompanied by varicocele and while the varicose veins, if excessive, should be removed, the neuralgic pain will not always be relieved. Certain industrial organizations and the military service require excision of varicose veins of the cord before the individual may be employed or enlisted.

Most authors advocate exposure of the spermatic cord through an incision beginning just above the external inguinal ring and extending on to the upper portion of the scrotum. The veins are less tortuous in this area and those

to be excised may be isolated more easily. However, the cord must be pulled upward and the more tortuous area exposed for ligation below; this appears to traumatize the cord.

A preferable incision is through the less vascular median raphe from the penis downward, or excision of a portion of the redundant scrotum (Fig. 589). In either case the cord is easily exposed from the upper part of the scrotum to the testicle. The fascial coverings are incised and all bleeding points are ligated. The fascia covering the cord should not be separated by blunt dissection (Fig. 590). Small torn blood vessels may be temporarily occluded by torsion and healing delayed by secondary bleeding. The redundant scrotum when not too excessive will gradually recontract after the testicle is held up by ligation of

Fig. 589—Line of incision for excision of redundant scrotum

the tortuous vessels and shortening of the cord This process is very slow and, in cases where the scrotum is greatly enlarged, excision of the excess gives the patient immediate impression of support which is very helpful, especially in the neurotic type of individual.

If the scrotum is to be resected, it is caught with an Allis forceps in the median raphe at about the junction of its upper and middle thirds and also at the junction of its middle and posterior thirds. The scrotum is lifted up and the redundant portion is cut away with scissors while making tension upon it (Fig. 589). The bleeding vessels are quickly caught with hemostats. Every bleeding point must be clamped. After complete hemostasis has been secured

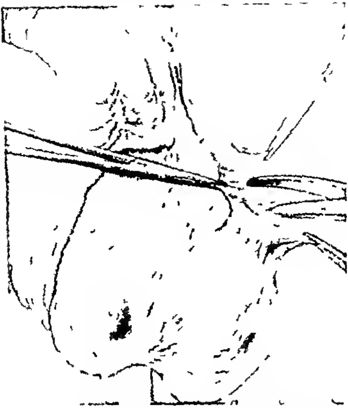

Fig 590 —Incision of fascia over spermatic cord to expose varicocele

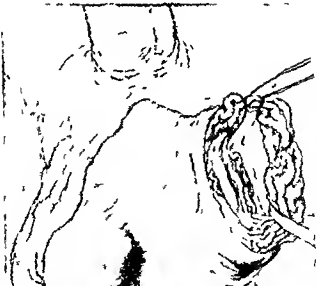

Fig 591 —Varicocele exposed and a portion of the dilated veins isolated and ligated

Fig 592 —A section of the veins has been excised and the stumps are tied together

Fig. 593 —The fascial coverings of the cord are sutured around a small rubber tissue drain

with the clamps, the vessels are tied with fine plain catgut. The varicose veins over the cord are exposed by incising the fascia along the cord and the vas deferens, together with the spermatic artery, is freely delivered into the wound. The spermatic artery is identified if possible. If this can be done the spermatic artery, with one or two veins, and the vas deferens are gently isolated and separated from the rest of the dilated veins (Fig. 591), but if it is impossible the largest varicose veins are freed and about two inches are removed after doubly ligating with catgut the upper and lower portions of the veins. If the spermatic artery can be recognized and isolated along with the vas deferens and a few

Fig. 594.—The subcutaneous tissue of the scrotum is closed with plain catgut. The operation is completed by suturing the skin with mattress sutures of 0 chromic catgut.

veins, the other veins may be safely removed after ligating them with catgut close to the testicle below and at the upper portion of the scrotum. It is best to put two ligatures on each end to avoid the possibility of the ligature's slipping. The ends of one set of ligatures on each stump are left long. After excising the intervening segment of veins the stumps are tied together by the long ends of the ligatures (Fig. 592).

When in doubt it is much better to take out too few veins than too many. The shortening of the cord produced by removing a segment of veins and ap

proximating the stumps, and resection of the redundant portion of the scrotum when necessary, will give such support to the testicle and structures of the cord that extreme, radical procedures in removal of the veins from the cord are not indicated. It is highly important to avoid injury to the spermatic artery. It is the principal source of blood supply to the testicle. Extensive excision of the veins may cause secondary hydrocele. Some surgeons complete the operation by everting the tunica vaginalis and suturing it behind the testicle. This is not necessary if sufficient veins have been left for an adequate return blood flow.

After carefully securing all bleeding points and tying them with plain catgut the fascial coverings of the cord are approximated with a few interrupted sutures of plain catgut. The wound in the scrotum is closed with a continuous mattress suture of 0 chromic catgut (Figs. 593 and 594). A small rubber tissue drain may be placed through the lower angle of the wound, to be left forty-eight hours to prevent ecchymosis or hematoma. This is rarely necessary if the exposure has been made carefully by sharp dissection and all bleeding points have been ligated. A light dressing and a snug scrotal support should be applied. The application of an ice bag for a few hours promotes contraction of the scrotal tissues and aids in the prevention of delayed bleeding.

Inguinal Varicocelectomy

Ivanissevich first advised high ligation of the internal spermatic vein for the surgical treatment of varicoceles. Many other surgeons have reported favorable results with this operation The following technique is that used by Dr. Carl Bunts, of the McGuire Veterans' Hospital, Richmond, Virginia:

An incision 6 cm long is made over the course of the inguinal canal with the distal extremity of the incision being over the external inguinal ring. This incision is carried through the skin and subcutaneous tissue down to the aponeurosis of the external oblique muscle. The aponeurosis of the external oblique is then opened in the direction of its fibers and the spermatic cord is isolated and picked up. The sheath of the cord is opened in its long axis. The bulk of the veins of the spermatic cord are isolated, leaving two or three veins posteriorly, along with the vas deferens and the spermatic artery (Fig. 595, *A*). These excess veins, which are not as dilated as those in the scrotum, are then stripped free for a distance of about 4 cm., doubly ligated and resected (Fig. 595, *B*). The proximal and distal stumps are tied together with the ligatures, leaving the ends of two of the ligatures long. The two ligatures left long at the approximation of the stumps of the cord are threaded on a round needle and passed through the lower edge of the internal oblique muscle near the internal ring, emerging about 1 cm. apart, and tied so as to form a mattress suture which serves as further traction on the cord, elevating the testis to a point about 2 cm. higher than its original position in the scrotum (Fig. 595, *C*). The incision in the sheath of the cord is approximated with plain 0 catgut in a transverse manner as against the vertical incision (Fig. 595, *D*). If a hernia is present, it is corrected by the method indicated, otherwise the aponeurosis of the external oblique

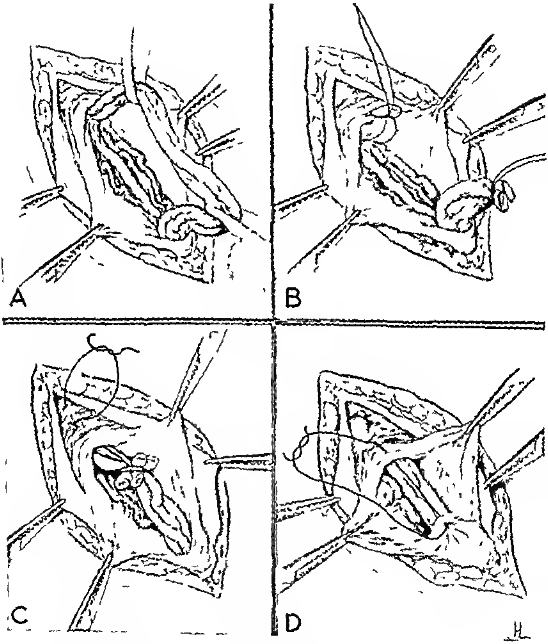

Fig 59a —Inguinal varicocelectomy technique used by Dr Carl Bunts

is closed with a continuous running suture of chromic 0 catgut. Adequate patency of the external inguinal ring is assured, the subcutaneous tissues are approximated with a few interrupted sutures of plain 0 catgut and the skin is closed with interrupted sutures of fine black silk

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CHAPTER XL

SURGICAL CONDITIONS OF THE TESTICLE AND THEIR TREATMENT

Injuries, Cryptorchidism, Ectopic Testicle, Orchitis, Tumors, Orchiectomy

Operations upon the testicle consist of plastic or corrective procedures, repair of injuries, drainage of abscesses and orchiectomy.

Plastic operations are often indicated when the testicle fails to descend into the scrotum (cryptorchidism) and in rare cases in which the testicle takes an abnormal course and descends to an unnatural location, such as the cruroscrotal fold or the base of the penis. The testicle must also be returned to the scrotum in cases of subluxation resulting from injury. Torsion of the spermatic cord when recognized soon after its occurrence should be corrected and the testicle sutured to the bottom of the scrotum to prevent recurrence of the accident.

The repair of injuries usually consists of opening and evacuating blood from a hematocele, the control of bleeding, and in some cases suture of a wound in the tunica albuginea.

Drainage of an abscess of the testicle is not often indicated. Most abscesses in the scrotum result from infection of the epididymis and the testicle is not involved unless the abscess has been neglected. When the testicle is involved orchiectomy is usually indicated. Occasionally in debilitated old men a wide incision and drainage are preferred when the entire testicle almost always sloughs out.

Orchiectomy is indicated in malignant disease of the testicle and when the testicle is tuberculous or has been destroyed by torsion of the spermatic cord, severe injury, or infection. Occasionally the compressed fibrotic testicle is removed with a large thick walled hydrocele.

INJURIES OF THE TESTICLE

The testicle may be dislocated from the scrotum by a direct blow, or it may be injured by a crushing or lacerating trauma. It may be punctured, incised or ruptured purposely or by accident. Because of the protected position of the testicle such injuries are unusual.

Luxation or Dislocation of the Testicle

Luxation or dislocation of the testicle may follow crushing injuries such as the passing of a wagon wheel across the pubis. Falling astride a hard object or a heavy blow on the perineum may force the testicle from the scrotum and cause it to rest beneath the skin of the thigh, at the base of the penis, in the

lower abdomen or perineum. Regardless of the severity of the injury the testicle and its blood supply often remain intact and can be replaced within the scrotum with ultimately satisfactory results.

The true condition is often not immediately recognized because of the tremendous swelling and ecchymosis of the scrotum and surrounding tissues. If the patient is examined early before so much local reaction has occurred, the absence of the testicle from the scrotum will be noticed. A painful, tender swelling at one of the areas usually occupied by the dislocated testicle and the history of the type of injury should make the surgeon suspect that dislocation of the testicle has occurred.

Treatment.—Frequently the shock resulting from additional injuries will not permit immediate operative treatment. A few cases have been reported in which the testicle was replaced by manual manipulation. When this can be done the scrotum should be supported and ice bags or cold compresses applied over the scrotum and testicle. When the testicle cannot be replaced by manual manipulation, operation should be resorted to as soon as circumstances will permit. The scrotum is opened, blood clots are evacuated and any bleeding areas ligated. The testicle is then freed from its abnormal position and replaced within the scrotum, drainage is supplied and the wound closed.

Wounds of the Testicle

Lacerations of the testicle may result from bullet wounds or penetration by a sharp object. The testicle is occasionally punctured by a needle or trocar while tapping a hydrocele or it may be incised during the process of a surgical operation. I once saw a man whose testicles had been so extensively cut maliciously that bilateral orchiectomy was necessary.

In the less extensive wounds, such as those made by a needle or small trocar, elevation and support of the testicle are usually all that are necessary. If there is an extensive hematocele incision and control of the bleeding are desirable. In lacerations or incisions the testicle should be exposed and the tunica albuginea carefully sutured. If the extrusion of tissue from the testicle interferes with approximation of the edges of the tunica the extruded tissue should be trimmed away with a sharp knife. When suppuration occurs in the testicle following injury orchiectomy should be done

CRYPTORCHIDISM

In a small percentage of males one or both of the testicles never descend normally into the scrotum. In such cases the testicle remains either in the abdomen or in the inguinal canal, or, having passed from the inguinal canal, remains in the upper part of the scrotum. It may be deflected beneath the skin of the inguinal area or to some more distant part, as the perineum, the base of the penis, or Scarpa's triangle. When the testicle takes an abnormal course and settles in a distant area, it is termed an ectopic testicle. This condition is very rare and the treatment consists of a surgical operation to free the testicle and place it in the scrotum.

Nondescent or incomplete descent of the testicle is quite frequently noted at birth The exact incidence is not definitely known William W Johnson found that one or both testicles has not descended in 544 of 31,609 (1 72 per cent) of boys examined between the ages of 7 and 17 years Of this group the testicles descended without treatment in 300 during the seven year period that this study included Between the ages of 11 and 13 the testes descended spontaneously in 174 boys The exact incidence of normal descent before puberty in this group could not be determined, since no follow up examination was made in 63 instances, and 157 were lost by removal from the community Keyes credited Coley with the statement that nondescent persists up to puberty in one in thirty and stated that it was found in less than 1 per cent of Army recruits during conscription

The cause or causes of failure of the testicle to descend into the scrotum before birth have never been definitely determined The anomaly seems to result from both biological and mechanical disturbances It is well recognized that in many instances testicles partly descended, or of the wandering type, reach the bottom of the scrotum and remain there at puberty Furthermore, the administration of gonadotropic hormones will in a fair percentage of cases cause descent of testicles retained in the inguinal canal or upper part of the scrotum There remains a group of patients who respond neither to the stimulating effect of hormones injected nor those appearing normally at the time of puberty The testicle may be prevented from entering the scrotum because of obstructive factors such as adhesions fibrous bands and abnormal attachment of the gubernaculum testis

Pathology—It is generally conceded that very little if any, pathologic change takes place in the undescended testicle before puberty D W MacCollum examined the semen of 22 men who had been operated upon for undescended testes during childhood Although the sperm count was not as high as the normal average, 82 per cent were fertile Following puberty development is retarded and there is thickening of the tunica albuginea and the basement membrane of the tubules The testicle is not so firm as the normal Spermatogenesis is deficient or absent It has been estimated that spermatogenesis persists to some extent in about 10 per cent of undescended testicles Carl Moore has demonstrated that when the testicles of animals are placed in the peritoneal cavity or inguinal canal, degenerative changes occur in the germinal cells When they are placed in the scrotum again, the germinal epithelial cells are restored to normal appearance and the animal is fertile The establishment of spermatogenesis in the adult cryptorchid following orchiopexy is doubtful Some surgeons advise removal of the undescended testicle when encountered in the adult For psychic reasons and the probable advantage of the testicle in the production of androgenic hormone orchiopexy is a better procedure

The processus vaginalis does not become obliterated above an undescended testicle consequently, hernia is not an unusual complication of cryptorchidism It is probable that the descent of testicles late in childhood is often a predisposing cause of hernias in later life

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transplanted testis and the control testis in the scrotum. The same experiment in adult dogs showed degeneration of the germinal epithelium in the transplanted testicle. It seems, therefore, logical to assume that the testicle will develop normally if it descends or is placed in the scrotum at any time before puberty. Other factors such as psychic disturbance of the child because of an unnatural condition, the danger of trauma or hernia, and anxiety of the parents, often make it desirable that treatment be instituted somewhat earlier. From seven to nine years of age is a very satisfactory period. The child is old enough to be easily controlled, and if operation is necessary the tissues are sufficiently developed to permit surgical correction without difficulty.

Medical Treatment.—Gonadotropic substances are contained in extracts from the anterior lobe of the pituitary gland and from the urine during pregnancy. The administration of this hormone in sufficient quantity will cause the testicles to descend in some cases and will frequently cause premature development of the external genitals. The preparations usually used in the treatment of cryptorchidism are the anterior pituitary like hormone derived from the urine of pregnant animals. The percentage of successful results obtained from this method of treatment varies considerably in the reports of different investigators. In a group of cases collected by Thompson and Heckel there were 860 undescended testes in 579 patients, 281 bilateral and 298 unilateral. Five hundred twenty four, or 61 per cent, of the testicles in this group descended while the hormone was being administered. In their own series of 38 patients with 50 undescended testicles, only 20 per cent of the testicles descended as a result of hormone therapy. Genital growth was produced in 17 of 31 patients treated for a prolonged period. They call attention to the frequency of the migratory type of testicles and those which can be manipulated into the scrotum. These will descend permanently without treatment at puberty. These authors found in eleven patients operated upon anatomical factors, such as adhesions, fibrous bands and abnormal direction of the peritoneal process, which prevented descent of the testicle.

The method of treatment with gonadotropic hormone does not seem to be very well standardized, particularly as to the size of the dose and the frequency of administration. Treatment reported varies from 100 rat units three times a week to 250 rat units a day. This, together with the selection of cases, certainly has some influence on the results obtained. A careful examination of different reports shows that in most of the successful cases descent has occurred within about two months. There does not seem to be any advantage in prolonged periods of treatment nor of repeated attempts to effect descent of the testicles by the administration of hormones. Eisenstaedt and his associates have observed degenerative changes in testicles treated with large amounts (more than 6,000 units) of anterior pituitary like substances, and were able to reproduce these changes in young animals by large doses of the hormones. No such changes were noted in the testicles of children receiving less than 4,000 units. It was their opinion that adhesions about the testicle were more pronounced in all cases so treated than in patients who were operated upon without preliminary

Torsion of the spermatic cord is believed to be caused, at least in part, by abnormal or incomplete descent of the testicle. A roomy tunica vaginalis and limited attachment of the testicle to the bottom of the scrotum permit torsion to occur.

Undescended testicles are subject to the same diseases that are found in normal testicles. Epididymitis or orchitis must be differentiated from inguinal adenitis. Any evidence of suppuration is an indication for orchiectomy because of the danger of peritoneal involvement. Torsion of the cord with the testicle in the inguinal canal simulates in some respects strangulated inguinal hernia. Immediate orchiectomy is indicated Tumor of the testicle is believed to occur in a larger percentage of undescended testicles than in those normally descended. Of 245 cases of tumor reported by Dean, 35 were in undescended testicles. Most of them were retained within the abdomen.

Treatment.—Both medical and surgical measures are used in the treatment of cryptorchidism. The purpose of treatment is to cause the testicle to descend or to place it in the bottom of the scrotum, and occasionally when this cannot be accomplished to remove the testicle and when considered desirable for psychic reasons to place in the scrotum an artificial testicle made of some nonirritating material. It is desirable that the testicle be placed in the scrotum so that it will develop normally, and to minimize the danger of trauma, malignant disease, hernia, and torsion of the cord. There is also at times some psychic disturbance because of the absence of the testicle from its normal location.

There remains some difference of opinion as to the appropriate time to begin treatment. McKenna states that it is generally agreed that the testicle that has not descended within the first twelve months after birth will not descend of its own accord. Johnson, previously quoted, found an incidence of 1.72 per cent cryptorchidism in 31,609 boys and observed normal descent in more than half of these. Descent occurred in the largest percentage of cases at the time of puberty. It is impossible to reconcile the wide variation in these statements. Perhaps a difference of opinion in what constitutes an ectopic testicle is to some extent responsible. In many cases the testicle is at one time in the canal and at another in the scrotum, and it is not unusual to find the testicles of small children near the top of the scrotum. In both of these groups eventual descent may be expected. A Negro boy was referred from the out-patient department of the Medical College of Virginia to the hospital for operation. To our surprise, on examining him in the hospital, the testicle for which operation had been requested was in the scrotum and the opposite testicle had receded into the inguinal canal.

Treatment should depend upon a very careful history and examination, and when practical a reasonable period of observation. There is no necessity of instituting treatment in early childhood unless evidence of endocrine disturbance or a complicating hernia requires it. There is no clinical or experimental evidence to indicate that there is any deterioration of the retained testicle until after puberty. Wangensteen transplanted one testicle to the peritoneal cavity in a series of pups and no difference was noted between the

angle of the wound into the scrotum, breaking adhesions and dilating the scrotum. The cavity is packed lightly with dry gauze until dissection of the testicle and cord has been completed. The gubernaculum is identified and divided near the testicle, leaving enough tissue to permit sutures to be placed either for fixation or traction. The cremaster muscle and fascia are divided, and the spermatic cord and the sac of peritoneum which contains the testicle are dissected out up to the general peritoneal cavity. The peritoneal sac is then opened and divided just above the testicle at a right angle to the cord. The peritoneum above the testicle is separated from the cord very carefully, and the upper portion is sutured or ligated at the entrance to the general peritoneal cavity as in closing the neck of a hernial sac. The lower pouch of the peritoneum is dissected from the cord and is sutured over the testicle loosely with a purse string suture. The removal of the peritoneal sac adds considerable length to the cord. Gentle traction on the cord with the peritoneum removed will demonstrate bands of adhesions that interfere with normal descent of the testicle. These bands are connective tissue and can be cut with scissors or torn with forceps. Extreme care must be taken in the dissection. The blood vessels are very small and easily torn. There is not only danger of disturbing the blood supply of the testicle, but hemorrhage into the tissues of the cord interferes considerably with the dissection. The cord is so dissected that only the blood vessels and the vas are left. When this dissection is completed the testicle will usually reach the bottom of the scrotum without tension. If it does not, the cord may be further lengthened by finger dissection in the upper angle of the wound, separating the vas deferens and spermatic vessels from the posterior layer of the peritoneum. The distance to be traversed by the cord can be shortened when necessary by dividing the transversalis fascia to the pubis, stripping the spermatic vessels from the peritoneum and bringing the testicle down behind the epigastric artery and vein as suggested by Wolfer.

When the testicle is ready to be placed in the scrotum, a mattress suture of coarse silk or silkworm gut is passed through the stump of the gubernaculum. Both ends of this suture are threaded through a large straight needle which is thrust through the most dependent portion of the scrotum. Traction is made on the suture, pulling the testicle to the bottom of the scrotum. One end of the suture is then removed from the needle and the needle is passed through the skin of the thigh at a point opposite the lower part of the scrotum. The ends of the suture are then tied together, approximating the scrotum to the thigh and anchoring the testicle to the bottom of the scrotum. The purpose of the suture is merely to hold the testicle in place while healing occurs. If the testicle does not quite reach the bottom of the scrotum or if there is tension on the cord, continuous elastic traction on the testicle is helpful in gradually lengthening the cord and preventing late retraction of the testicle. When traction is to be used the ends of the suture that has been placed in the gubernaculum and passed through the bottom of the scrotum are removed from the needle and tied together. The loop thus formed is attached to a thin rubber band which is fastened to the thigh with adhesive under slight tension (Fig 596). The band must be watched and adjusted from time to time to maintain an even and continuous

hormone treatment. Other objections offered to the prolonged administration of the hormone are the possible effect on closure of the epiphyses and skeletal growth and premature development of the external genitalia. It is evident that the administration of the anterior pituitary-like hormone has a very definite place in the treatment of undescended testicles. It should not be administered to very young children, certainly not before the fourth or fifth year, and should be discontinued if there is evidence of increased growth, except in cases of Frohlich's syndrome or when the genitals are abnormally small. If the administration of 2500 to 3000 units over a period of six or eight weeks does not cause definite evidence of descent, there is little probability that success will be obtained by this method. The hormone treatment is contraindicated in patients past puberty and in those cases complicated by hernia.

Surgical Treatment.—Surgical treatment is indicated in complicated cases when other methods fail or their administration is impractical, and when the patient has passed the age of puberty. The purpose of all operations advised for the treatment of undescended testicles is to lengthen the spermatic cord sufficiently without injuring its blood supply to permit the testicle to be placed and retained in the bottom of the scrotum. The principles of the Bevan operation of freeing the spermatic cord from its fascial and peritoneal coverings and dividing adhesions which bind the vas deferens and blood vessels of the cord are generally applied. A purse-string suture at the neck of the scrotum is also advocated by Bevan to prevent the testicle from slipping back into the inguinal canal. Although the testicle may be placed in the scrotum without tension and the neck of the scrotum sutured snugly around the cord, there is a tendency for retraction to occur, and in many cases the testicle is found later to occupy the upper part of the scrotum or even to have retracted into the inguinal canal. To overcome this tendency to recurrence, the testicle may be attached to the thigh or to a splint until it has become permanently fixed in place. If the spermatic vessels are divided to add length to the cord, the artery accompanying the vas deferens proves insufficient and the testicle atrophies Occasionally there is some difficulty in obtaining sufficient length of the cord, but with careful dissection this can usually be accomplished even when the testicle is retained in the peritoneal cavity. If the testicle cannot be brought to the bottom of the scrotum, it should be placed as low as possible and slight elastic traction applied If necessary a second operation may be done several months later. The testicle should be removed only when diseased or because of torsion of the cord.

Operative Technique—An incision is made parallel to and about an inch above Poupart's ligament in the same manner as when operating for the repair of an inguinal hernia. The aponeurosis of the external oblique muscle is opened near the internal inguinal ring and split in the direction of its fibers through the external ring. Care should be taken to avoid small nerve trunks that run beneath the aponeurosis The testicle is usually found in the canal or at the external ring, firmly fixed by its coverings and the gubernaculum. At this stage of the operation it is well to make a pouch in the vacant scrotum. This is done by inserting first one index finger, and then both, through the lower

inguinal hernia. The aponeurosis of the external oblique is closed with a continuous suture of No. 1 chromic catgut and the skin with a continuous suture of fine chromic catgut or silk.

Torek's method of orchidopexy is somewhat more tedious and time consuming, but the late results are usually more satisfactory. The cord is lengthened and the hernia repaired as in the Bevan operation. When the testicle can be brought down to its normal position, an incision about 1½ inches long is made down to the fascia lata on the inner surface of the thigh obliquely from above downward and inward, and at a point where the testicle will lie without undue traction. The fingers are inserted into the scrotum from the inguinal wound to stretch the scrotum and prepare a pocket to receive the testicle. An incision

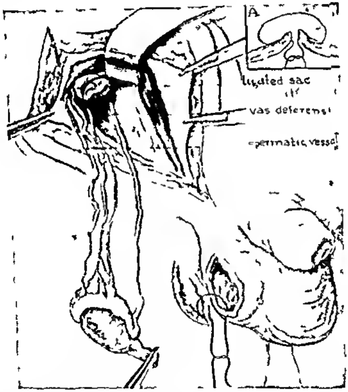

Fig. 597.—Torek's method of orchidopexy. The hernia sac has been removed and the stump ligated. The cord has been freed of adhesions until the testicle can be brought into the scrotum. The scrotum has been prepared and incisions are made in the scrotum and skin of the thigh preparatory to suturing the testicle to the fascia lata. Insert shows method of suturing posterior edge of scrotal wound to that of thigh so that skin margin will turn out.

about 1½ inches long is made in the lower outer portion of the scrotum extending into the cavity. The posterior edge of the scrotal wound is then sutured to the margin of the thigh wound (Fig. 597). Since this row of sutures will be inaccessible, absorbable sutures should be used. The testicle is brought down into the scrotum (Fig. 598) and sutured to the fascia lata by two or three No. 1 chromic catgut sutures which go through the tunica albuginea (Fig. 598 A). The anterior edge of the scrotal wound is sutured to the lower edge of the wound in the thigh, so covering the testicle (Fig. 599). In order to prevent undue traction on the wound, it is well to fasten the thighs together for a few days. The

tension. It is well to place two sutures from the gubernaculum through the scrotum, leaving one unattached to be used if the first suture cuts through the tissues. This method of traction has been advocated in principle by Hugh Cabot. When there is tension on the cord I have found the Torek operation more satisfactory.

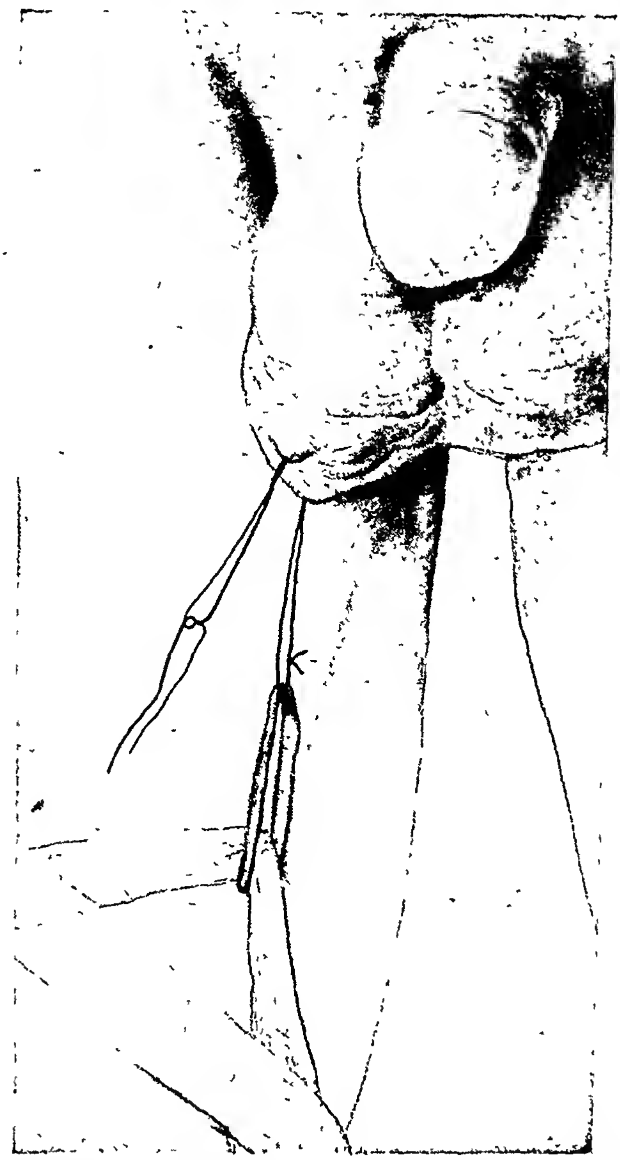

Fig. 596.—Elastic traction applied to hold the testicle down following the Bevan operation for undescended testicle. A heavy silkworm-gut suture is taken in the gubernaculum and both ends of the suture are threaded in one needle and carried through the most dependent portion of the scrotum. The ends of the suture are tied together through a rubber band which is drawn slightly taut and fastened to the thigh with adhesive. Continuous elastic traction is maintained for about three weeks. An accessory suture is placed, to be used if the first suture pulls out.

When the testicle has been disposed of, a purse-string suture is taken through the subcutaneous tissue at the top of the scrotum and tied lightly so as not to compress the circulation of the cord. The wound is closed by suturing the conjoined tendon to Poupart's ligament over the cord with interrupted sutures of No. 1 chromic catgut as advocated by Ferguson in the treatment of

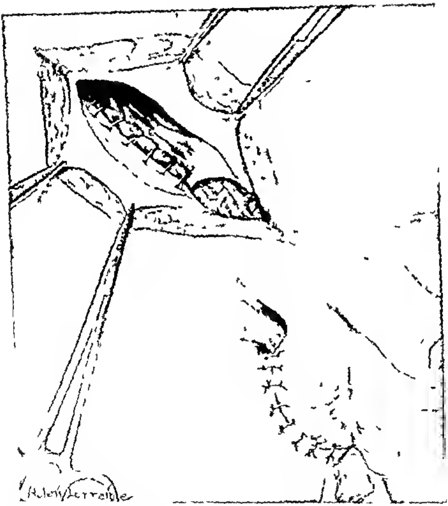

Fig 599.—The anterior lip of the scrotal wound has been sutured to that of the thigh securely covering the testicle Closure of the abdominal wound completes the operation. The testicle is separated from the thigh three or four months later

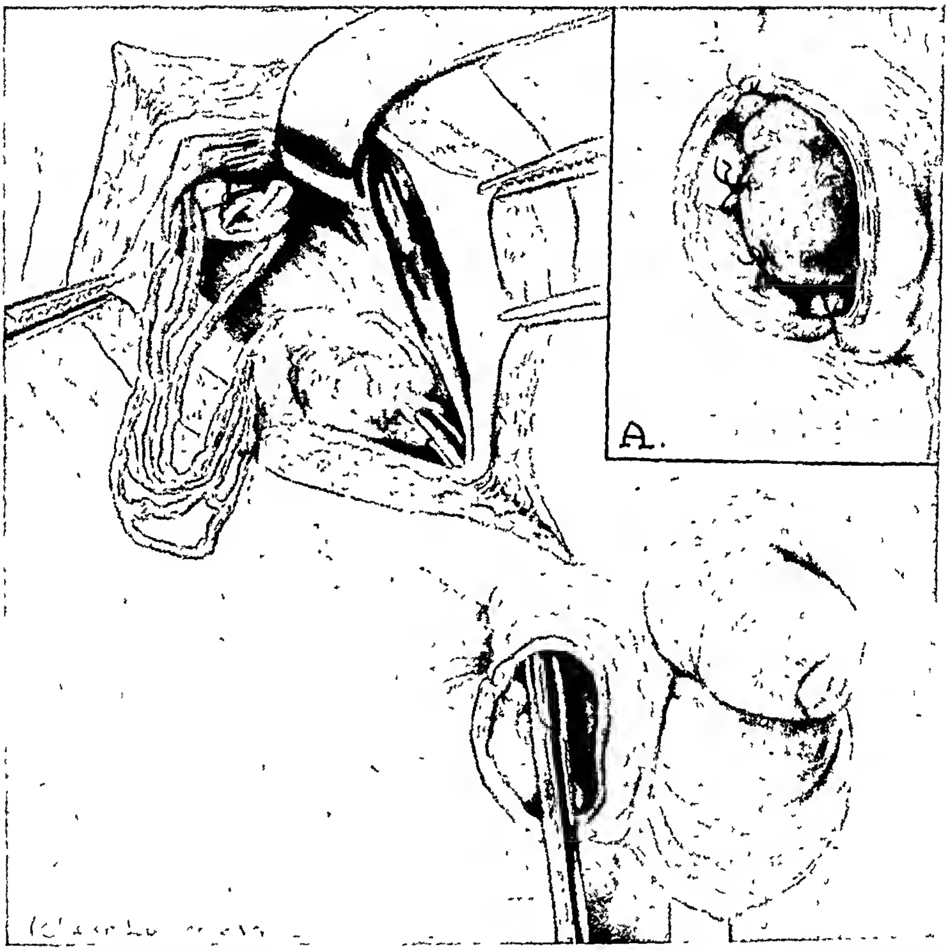

Fig 598 —Forceps inserted through the scrotal wound grasp the gubernaculum and pull the testicle in place Inset *A* shows interrupted suture, fixing tunica albuginea to fascia lata Some surgeons, for fear of injuring the testicle, prefer to suture the gubernaculum to the fascia lata

cord toward the testicle until sufficient exposure is obtained to free the testicle. If it is held in place by the gubernaculum this is divided, leaving sufficient stump with which to anchor the testicle. With the testicle and cord entirely free the testicle is attached to the bottom of the scrotum and the operation is completed as described for undescended testicle.

ORCHITIS

Infection of the testicle may occur as a complication of epididymitis or as a result of systemic infection. Cases are reported as complications of almost all of the infectious diseases and particularly of typhoid fever, smallpox and mumps. As a complication of these diseases the testicle does not suppurate and consequently is rarely submitted to surgical treatment. Ballenger and Elder have advised multiple incisions through the tunica albuginea for the relief of tension in the orchitis of mumps, and report cases with normal spermatogenesis following this operation. Multiple puncture of the testicle and epididymis has been done for the same purpose. Cortisone is recommended for orchitis of mumps.

Suppurative Orchitis

Suppurative orchitis may complicate acute epididymitis following instrumentation or introduction of a catheter or as a result of pyogenic infection of the prostate and seminal vesicles. Infection of the testicle does not occur in gonorrheal involvement of the epididymis. Orchitis also arises as a metastatic disease from such septic foci as furunculosis and osteomyelitis and occasionally when no definite predisposing cause can be determined. Keyes states that those cases of secondary involvement of the epididymis are always infected by the colon group of organisms.

It is usually difficult to differentiate suppurative orchitis from acute epididymitis. The history of the case and a knowledge of the source of the infection are helpful. Gonorrhea does not involve the testicle and metastatic involvement of the epididymis alone probably does not occur. Epididymitis occurring in the course of prostatism or pyelonephritis is apt to spread to the testicle. The pain and tenderness are usually more severe than in epididymitis and constitutional symptoms such as nausea, fever and delirium are much more pronounced. The onset of pain is often quite sudden and may radiate to the inguinal region or to the perineum. When the inflammation is confined chiefly to the testicle the swelling is not excessive because of the unyielding character of the tunica albuginea. Hydrocele is insignificant but there are edema and congestion of the scrotum. Cessation of pain without corresponding decrease in the size of the inflamed area indicates necrosis of the testicle.

Treatment.—The early treatment is palliative. The inflamed testicle is supported by an adhesive bandage. In the beginning of the inflammation ice bags may give considerable relief, later, heat seems more desirable. In pyogenic infections sulfonamides or antibiotics should be given orally if tolerated, otherwise antibiotics may be given parenterally. In fulminating cases of epididymitis early drainage of the epididymis may prevent extension to the testicle. When suppuration has occurred in the testicle orchiectomy should be done.

scrotum and testicle are left attached to the thigh from four to six months During this time the scrotum becomes permanently enlarged and the testicle firmly fixed in the lower part of the scrotum. At the second stage of the operation the scrotum is separated from the thigh and the testicle dissected from the fascia lata The wounds in the scrotum and thigh are sutured The testicle remains at the bottom of a well-formed scrotal sac.

When the condition is bilateral, the operation is done in three stages. At the first operation one testicle is brought down and fastened to the thigh. At the second operation the first testicle is released from the thigh and the second is brought down, and finally the second testicle is released.

ECTOPIC TESTICLE

When in the course of its descent the testicle is deflected from the normal course and lies outside that path the condition is known as ectopia. This condition differs from cryptorchidism in that the cryptorchid testicle lies at some point along the normal course of descent.

The ectopic testicle may be (1) interstitial, lying external to the aponeurosis of the external oblique muscle; (2) genital or crural, lying in Scarpa's triangle, (3) penile, lying between the base of the penis and the pubic bone, (4) transverse, when both testicles descend through the same inguinal canal; or (5) perineal, when the testicle is in the perineum, usually firmly attached by a band of tissue to the ischium.

The cause of this anomaly is rather obscure. The theory of the multiple attachments of the gubernaculum, the testicle being conducted toward the strongest pole, is usually mentioned. Some writers believe that some obstruction at the entrance to the scrotum, perhaps a tight scrotal aperture, may require the testicle to take the course of least resistance. The ectopic testicle lies between the superficial and deep layers of fascia.

Diagnosis.—The presence of a small sensitive mass in one of the locations mentioned and the absence of the testicle in the scrotum are the most positive evidences of ectopic testicle. When atrophy of the testicle has occurred there is very little evidence of the anomaly and it may go unnoticed Although the condition is rare the possibility should be remembered and careful examination made in cases of undescended testicle. The perineum is the most frequent site of ectopic testicle. Infection or injury may call attention to the condition.

Treatment.—Operation is the only means of correcting the condition. The cord is usually of sufficient length—it is only necessary to dissect the testicle free and transplant it to the scrotum. The incision and operative technique vary according to the location of the testicle. An incision should be made over the lower portion of the inguinal canal, exposing the external ring, the entrance to the scrotum and the beginning of the ectopic portion of the cord. A pouch is then made in the scrotum to receive the testicle and the cavity is tightly packed with gauze as described in operation for undescended testicle By making gentle traction on the cord and retracting the margin of the wound it may be possible to liberate adhesions and draw the testicle into the wound If this cannot be done the lower end of the incision should be continued over the ectopic

These tumors are found with slightly greater frequency on the right side. The incidence in undescended testes appears to be definitely greater than in those normally descended. Keyes and Ferguson express the belief that this may result from the higher incidence of embryonal rests in testes which are themselves the result of faulty embryologic development.

It is the opinion of Ewing that malignant tumors of the testicle are a one sided development of a teratoma. The main varieties, according to his classification are (1) adult embryomas or teratomas, (2) embryoid, teratoid or mixed tumors and (3) embryonal malignant tumors. *Adult embryomas constitute* a small group. They are cystic, sharply circumscribed tumors separated from testicular tissue by a capsule and fused with the rete. They are composed of a mixture representing many of the tissues that may originate from any or all of the three primary germ layers. They are irregular in contour and grow slowly. They may remain entirely benign or may develop into malignant tumors after a long period of growth.

Teratoid, embryoid or mixed tumors are composed of more or less embryonal structure but arranged in a much more confused manner than the tissues of adult embryomas. They may be of moderate or large size, solid or cystic. They develop from the rete and are well encapsulated. The cysts are lined by squamous or cylindrical cells and the solid portions contain various types of embryonal tissue such as cartilage, bone, and muscle. Although the tissues may be comparatively adult in structure and the tumor quite benign, one type of tissue usually overgrows the others and true malignant qualities are exhibited. The tumor may be classified on microscopic examination according to the cell layer that predominates.

Embryonal malignant tumors, sarcoma testis and seminoma compose the largest group of tumors of the testis. They are rapidly growing, solid tumors. The consistency varies somewhat with cell structure and age of the tumor. In advanced cases central necrosis is found. The cells are usually large. They may be round or polyhedral with hyperchromatic nuclei and are diffusely distributed or lie in wide sheets. The stroma may be scanty or may be richly infiltrated with lymphocytes. This latter type is sometimes classified as embryonal carcinoma with lymphoid stroma. Seminoma grows more slowly than other tumors of this group and metastasizes later. It is usually found in the older age group. The cells are uniform and usually arranged in unorganized masses of cords divided by trabeculae of connective tissue. The cells are sharply outlined and the cytoplasm is often clear. The nuclei are centrally placed and clearly outlined by a membrane. The remaining testis tubules are not invaded.

Embryonal adenocarcinoma is one of the most malignant types of this group. It grows rapidly, is very vascular, and is frequently the seat of hemorrhage. It is of greater density than seminoma and the surface may be somewhat irregular. It is composed of large cuboidal cells in irregular alveoli, or the cells may be smaller and the alveoli less distinct.

Chorioepithelioma of the testis is also extremely malignant. It originates from the rete testis and may metastasize extensively without causing appreciable enlargement of the testicle. The growth produces the essential features of uterine

TUMORS OF THE TESTICLE

Tumors of the testicle represent between 3 and 4 per cent of all tumors of the genitourinary system and, with the possible exception of renal tumors in childhood, are the most malignant growths encountered. Benign tumors in this area are extremely rare. Tumors of the testicle are essentially a disease of early adult life, the average age being about 32 years. With few exceptions they occur before the age of forty. These tumors are infrequent in children Of 246 admissions for tumor of the testicle at the Memorial Hospital in New York only 7 were under 15 years of age.

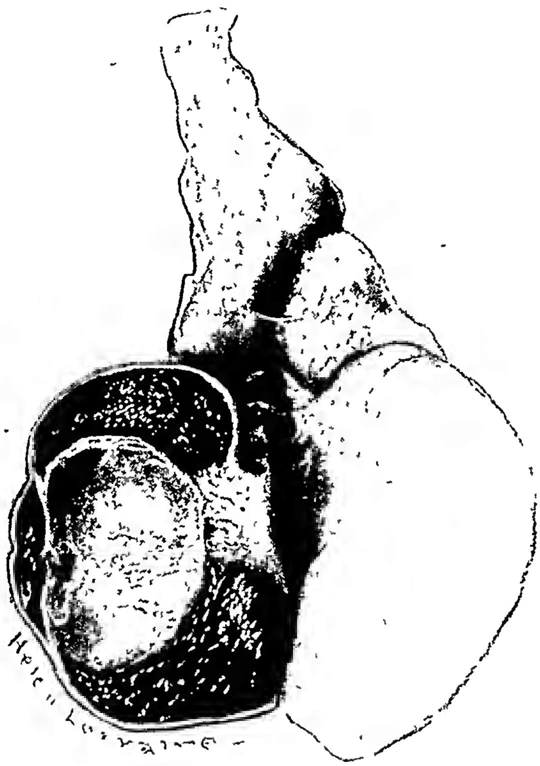

Fig 600—Degenerated embryoma of testicle following x-ray treatment No active cells could be found Patient well fifteen years following orchiectomy and x-ray treatment

The etiology of these tumors is as obscure as that of other malignant tumors. They are generally recognized to be of teratoid origin A history of injury is frequently obtained but this is not considered to be a causative factor except that trauma may stimulate the growth of a tumor already present In most cases an injury only calls attention to a tumor already present In my own practice a physician was kicked on the testicle by his small child (Fig 600). Examination disclosed a small nodule at the center of the right testicle The testicle was removed within two weeks of this discovery. The diagnosis was seminoma. X-ray treatment was given over the lymphatic drainage. The patient has remained well now a little more than fifteen years. It is extremely fortunate when the injury occurs at an early stage of the development of the tumor.

clavicular nodes may be the first evidence of extensive metastasis Extensions through the blood stream may involve distant organs Those most frequently invaded are the lungs, liver and brain

Diagnosis—An early diagnosis is the most important step in the successful management of tumor of the testicle The patient usually complains of a gradual painless enlargement of the testicle In some cases the first knowledge of any enlargement of the testicle follows a slight injury In my own practice one patient first noticed the enlargement when kicked by a child (Fig 600) and another following a slight injury while unloading a heavy box from a truck The first patient was a physician who sought relief within a week, the second consulted a physician who treated him by external medication and a suspensory four weeks before advising a consultation The disease usually occurs between twenty and forty years of age but may be seen at any age It is not accompanied except by coincidence by pyuria, urinary frequency or a history of infection as is so frequently found in inflammatory disease of the epididymis and testicle There is infrequently pain or tenderness of the testicle

On examination the normal contour of the testicle is usually preserved In early cases the epididymis can be identified, later with considerable enlargement it cannot be palpated separately (Fig 602) In early cases the surface is smooth and the growth is firm but not hard, later the surface may be irregular and there may be areas of fluctuation The spermatic cord appears normal and the skin of the scrotum is freely movable over the tumor except in very late cases when there may be involvement and ulceration of the scrotum In late cases the veins of the scrotum may be quite prominent

Tumor should never be confused with acute epididymitis orchitis or torsion of the cord in which there are severe pain, tenderness fever and usually leukocytosis, nor with tuberculosis of the testicle with the history, urinary symptoms induration of the prostate and vesicles and early involvement of the scrotum Hydrocele is a fluctuant tumor that transmits light except in long standing cases with greatly thickened sacs Here the chronicity of the disease and the elongation of the mass are usually sufficient for differentiation Hematocele in the acute form is painful and tender, with a history of trauma, in the chronic form it is similar to long standing hydrocele Syphilis produces a very hard heavy testicle with complete loss of sensation and a positive Wassermann

The usual appearance of a gonadotropic hormone, prolan A, in the urine of most patients suffering with embryonal tumor of the testicle is of importance not only as a method of diagnosis but as a means of prognosis as well Keyes and Ferguson state that of 240 consecutive cases of teratoma testis in which the quantitative excretion of prolan A was determined the hormone was found in all patients in whom the growth was unaffected by treatment The amount varies according to the degree of malignancy and the volume of tumor tissue either local or metastatic The excretion of chorioepithelioma may exceed 100 000 mouse units per liter of urine, while cases of seminoma observed by Keyes and Ferguson excreted from 400 to 2000 units per liter and five cases of the adult type of teratoma excreted from 50 to 500 units per liter Twiss O Powell has

chorioma. Hypertrophy of the breasts with secretion of cholesterin is occasionally reported. In most cases the patient first presents himself because of some metastatic lesion.

Extension of the tumors usually occurs through the lymph channels. In the more malignant forms metastasis occurs by way of the blood stream. The lymph

Fig 601

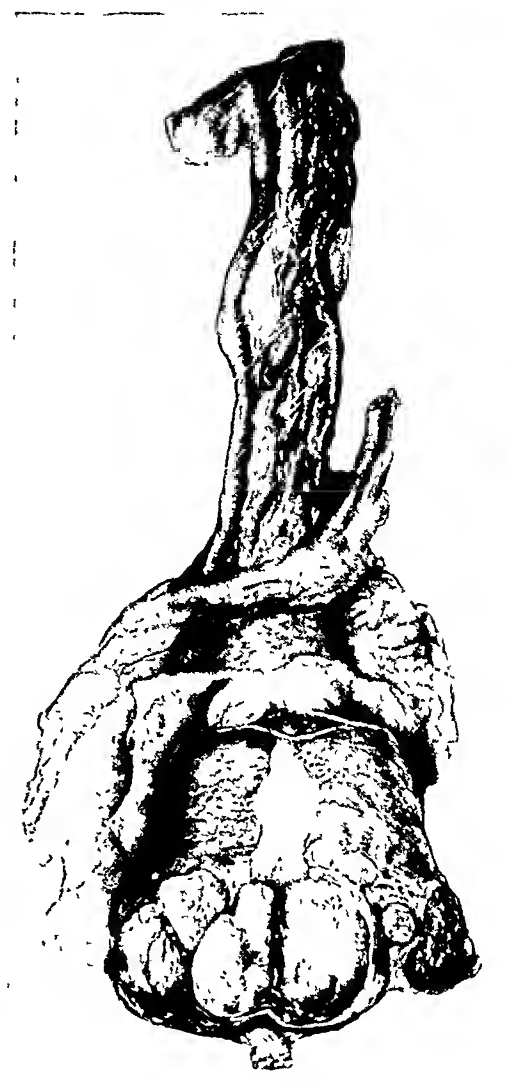

Fig 602

Fig. 601 —Embryonal carcinoma of the testicle, extremely malignant, abdominal mass discovered before primary growth was recognized

Fig 602 —Well-advanced embryonal carcinoma of the testicle

channels from the testicle accompany the blood vessels through the inguinal canal and pelvis to the lumbar lymph nodes. An epigastric tumor resulting from involvement of the retroperitoneal nodes at the celiac axis is often the first evidence of metastasis (Fig. 601). From the epigastric nodes the disease extends to the thoracic and supraclavicular nodes. Enlargement of the left supra-

clavicular nodes may be the first evidence of extensive metastasis. Extensions through the blood stream may involve distant organs. Those most frequently invaded are the lungs, liver and brain.

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shown that the quantity of hormone excreted can be fairly accurately correlated with the histologic classification of tumors of the testis. In the opinion of Hinman and Powell the finding of 300 mouse units per liter is strong evidence that the mass in the testicle is an embryonal tumor but if the test shows less than this or is entirely negative the possibility of a malignant tumor should still be considered. About a fifth of their patients later proved to have a malignant tumor did not excrete the hormone. The test should be made whenever facilities are available but like other laboratory methods is an accessory to diagnosis. A testicle containing a mass that may be a tumor should be removed and the diagnosis made by microscopic study. In doubtful cases exploration is the procedure of choice. Biopsy or needle puncture should not be done.

Metastatic masses in the abdomen or in the left supraclavicular area are late manifestations of tumor of the testis. They should not be necessary as diagnostic evidence. These areas should be examined in all cases of tumor or suspected tumor. Occasionally in rapidly growing tumors such masses are present when the physician is first consulted. Definite evidence of metastasis is of value in determining the method of treatment to be instituted and in prognosis.

Treatment.—The most effective treatment for tumor of the testicle is orchiectomy and irradiation combined. Wasterlain's studies show that orchiectomy alone is effective in only 6 per cent of cases. Hinman by radical dissection of the retroperitoneal glands found 19 per cent of his patients well at the end of five years Barringer and Dean in 1928 reported 29 2 of 154 patients treated by irradiation free of disease at the end of five years. Of this group 89 per cent were considered inoperable at the time of admission. Since this report, the Coutard method of fractional irradiation has been developed, which permits larger doses of irradiation with greater tolerance of the patient to the treatment. More recently Barringer has reported five-year survivals in 56 per cent of 55 patients with seminoma and 83 per cent of 12 patients with adenocarcinoma There remains some difference of opinion as to the method of applying the treatment. Hinman and Powell advise immediate orchiectomy to be followed by irradiation and in some cases radical dissection of the gland-bearing area. They point to the fact that severance of the cord at the internal inguinal ring as the first step of the operation immediately interrupts both the lymph and circulatory connection of the testicle, permitting orchiectomy without further spreading the disease, and the advantage of obtaining fresh tissue for microscopic examination and estimation of the prolan content from the tissue juices. In this way the tumor is more accurately classified and the indications for further treatment and the prognosis are more accurately determined They state that when there are no demonstrable metastases and the hormone prolan A promptly disappears from the urine no further treatment is indicated at the time The patient is advised to return at three-month intervals for examination and prolan estimation. Evidence of metastasis by physical examination or prolan estimation is an indication for irradiation of the gland-bearing area. Patients who have demonstrable metastasis or persistence of the hormone following excision of

the tumor are treated by irradiation immediately They also advise that following irradiation dissection of the gland bearing area be done in those cases in which histological and hormonal studies indicate that the tumor is radioresistant The persistence of the hormone following irradiation indicates the presence of viable metastasis Tumors with cells of the adult type are apt to be more radio resistant than those with immature cells It seems that with this program of treatment, particularly in view of the fact that only about 6 per cent of tumors are cured by orchiectomy, metastasis in many cases would be permitted to progress to a considerable extent before irradiation is begun Immediate irradiation appears to be a logical procedure The testicle and cord should be cleanly removed and the roentgenologist can expend his entire efforts on the gland bearing area Minute metastasis would produce very small amounts of prolan and in many places the test is not available so the probability of cure is greater if radiotherapy is administered to all patients immediately following operation regardless of prolan determination or histological structure of the tumor

Many surgeons who have discussed the subject prefer thorough irradiation of the testicle and gland bearing area to be followed by orchiectomy Randall and Bothe advise irradiation beginning at the periphery of the gland bearing area and finally including the testicle The patient is irradiated from the chin to the tuberosity of the ischii anteriorly and posteriorly The testicle is then removed They found viable tumor cells in specimens removed, indicating the fallacy of depending upon irradiation alone In some cases irradiation had very little effect The one advantage of preoperative irradiation is that a fairly accurate estimate of the tumor s resistance to this form of therapy can be obtained Randall and Bothe call attention to the probability of spreading the tumor by the effect of trauma when heavy doses of irradiation are given the tumor and advise a small protracted dose to the tumor after an attempt to prepare a field resistant to tumor cells by preliminary treatment to the area affected by metastasis Frank E Adair advocates preliminary irradiation of the testes, the lower quadrants of the abdomen, the suprapubic and inguinal areas Six weeks later the testicle is removed to be followed by irradiation by divided doses from the level of the diaphragm to the trochanters He states that Ferguson by the use of this technique has obtained freedom from disease for three years in fifty six per cent of patients treated

Lewis, in a study of 250 patients treated at Walter Reed Hospital found that there was considerable variation in the radiosensitivity of tumors of different cell structures Seminomas were very sensitive to radiation, requiring less than 1000 r for complete destruction of the tumor Undifferentiated carcinoma required about 2000 while some adenocarcinomas required a 3000 r dose In cases of chorioepithelioma and tumors of trophoblastic tissue a dose of 5000 to 6000 r was required He therefore advised simple orchiectomy followed by radiation therapy for seminoma and orchiectomy with radical resection of the retroperitoneal nodes in all other malignant tumors of the testis Following the radical operation roentgen therapy is advised in undifferentiated carcinoma and adenocarcinoma The dosage required for the more resistant types of

tumors is at times followed by late gastrointestinal complications, consequently, in his opinion, roentgen therapy in such cases should be reserved for inoperable metastasis Lewis did radical operations on 169 selected cases. There was no operative mortality. The final results in these patients should be very informative Sauer, Watson and Burke analyzed 202 cases of tumor of the testes treated at the Roswell Park Memorial Institute over a 25-year period. The five-year cure rate was 48.9 per cent, while 34 7 per cent of 101 patients treated before December 31, 1936, were living in 1948. They also found that a majority of deaths, 68 4 per cent, occurred within two years, while the death rate in the succeeding three years averaged 10 per cent a year. Only three patients that survived the five-year period died of the disease. End results were most favorable in the seminoma group while the highest mortality was in patients with embryonal carcinoma.

From information gained in the study of these cases, the essayists recommend orchiectomy with regional lymph node dissection followed by x-ray therapy in radioresistant tumors and simple orchiectomy and x-ray therapy in seminoma They suggest a minimum dose of 2000 r with larger doses when treating the more radioresistant tumors It has been my custom to advise the maximum amount of x-ray therapy that is consistent with safety in all cases. Even in the more radiosensitive tumors it is difficult to prove the nonexistence of radioresistant elements.

In all cases, following the initial period of treatment the patient should return for periodic examination and prolan estimation at periodic intervals for at least five years and for further x-ray treatment as indicated.

ORCHIECTOMY

Removal of the testicle may be necessary because of tuberculous or pyogenic infection, torsion of the cord, extreme injury, or malignancy. Orchiectomy is occasionally the operation of choice in undescended testicle and in very large, thick-walled hydrocele. For nonmalignant conditions an incision is made over the anterior surface of the upper part of the scrotum, beginning at the external ring and extending downward for a sufficient distance to permit the testicle to be delivered from the scrotum. If there are fistulas, or if the scrotum is adherent to the testicle, this diseased area should be surrounded by elliptical incisions and removed with the testicle

When the incision is made through the skin and dartos, the cord should be liberated at the external ring, doubly clamped and divided and the proximal stump ligated. This prevents the possibility of squeezing infectious material into the blood stream. The clamp on the distal stump of the cord is left on and used for traction as the testicle is dissected from the scrotum. This dissection is made by dividing the fibers of the loose layer of fascia which connects the dartos layer of the scrotum to the intercolumnar fascia which is the outer fibrous covering of the testicle. The dissection can be made for the most part with gauze or the finger tips, dividing the more resistant strands of tissue with scissors. It is necessary to clamp and tie every bleeding vessel, even the most minute.

If the operation is for malignant disease, it should be somewhat more radical. The incision is begun just above the internal ring and is extended downward and inward over the inguinal canal and on to the scrotum (Fig. 603). If any portion of the scrotum is the least adherent, the incision, when reaching the scrotum, should surround the adherent portion by a wide margin. The inguinal canal is exposed as in the operation for hernia, and the flaps of the aponeurosis of the external oblique are retracted. The cord is dissected from its bed at the internal ring, doubly clamped, and divided as high as possible. It is usually more satisfactory at this level to clamp and divide the vas and the blood vessels separately. The upper stumps of the vas and blood vessels are ligated. The clamps are left on the lower stumps and, as gentle forward traction is made, the cord is dissected from its bed. The cutting high frequency electrode is very satisfactory

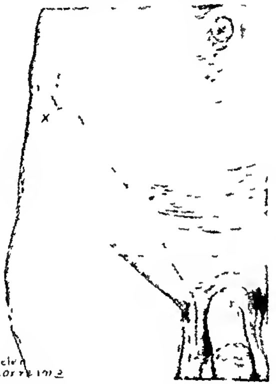

Fig. 603.—Line of incision for radical orchiectomy.

for this purpose. As the traction on the cord is continued, the testicle is pulled into the wound and the dissection is continued (Fig. 604), separating the fibers of Cowper's fascia close to the dartos layer of the scrotum. After clamping and tying all bleeding vessels, a rubber tissue drain is placed in the cavity of the scrotum and brought out at the lower angle of the wound. The wound in the scrotum is closed by deep mattress sutures of coarse silk or silkworm gut. In the operation for tumor, the inguinal portion of the incision is closed in layers, the aponeurosis of the external oblique muscle with a continuous suture of No. 1 chromic catgut (Fig. 605) and the skin with continuous or interrupted sutures of silk.

When orchiectomy is done for the treatment of carcinoma of the prostate it is only necessary to remove the parenchyma of the testicle. An operation that leaves the remaining structures of the scrotum undisturbed is more satisfactory. The following operation causes very little change in the appearance of the scrotum, which is a definite psychic advantage in some patients

The spermatic cords are isolated with the finger and thumb just below the external ring and thoroughly infiltrated with ½ per cent solution of Novocain. One testicle is then pressed against the median raphe near the bottom

Fig 604—Spermatic cord divided at the internal ring and removed with the fascial coverings from above downward If any portion of the scrotum is adherent to the testicle, it is excised and removed with the testicle and covering

of the scrotum, and after infiltrating the scrotal wall with Novocain, an incision is made in the raphe and continued through the coverings of the testicle. Very little bleeding is encountered in this area. The testicle is delivered and the tunica albuginea incised the length of the testicle The margins of the incision in the tunica albuginea are grasped with hemostats and the parenchyma of the testicle stripped off with a sponge (Fig 606). The blood vessels are ligated and the tunica albuginea closed with a continuous suture of fine plain catgut

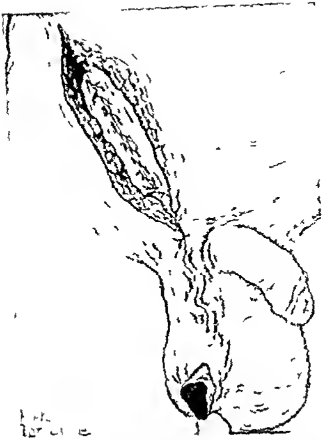

Fig 605 —Closure of wound following excision of spermatic cord and testicle

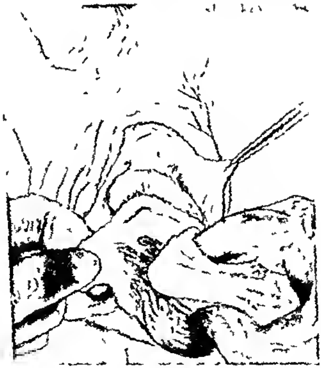

Fig 606 —Excision of the testicle for the treatment of carcinoma of the prostate The testicle is exposed the tunica albuginea divided and the parenchyma curetted out with dry gauze The vas deferens is ligated and the tunica albuginea sutured over with a continuous suture of fine plain catgut The scrotum is closed with drainage

The tunica vaginalis is closed with a similar suture. The vas deferens is isolated near the epididymis, doubly ligated and divided. The testicle is returned to the scrotum and the other testicle treated in the same manner. A small rubber tissue drain is placed in each side of the scrotum and brought out at the lower angle of the wound. The wound is closed with a continuous mattress suture of fine plain catgut. There is no shock and very little tissue reaction. A suspensory is applied and the patient permitted to be out of the bed the following day.

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CHAPTER XLI

SURGICAL CONDITIONS OF THE EPIDIDYMIS, VAS DEFERENS AND SEMINAL VESICLES AND THEIR TREATMENT

Epididymitis, Occlusion of the Epididymis and Vas Deferens, Seminal Vesiculitis, Tuberculosis of the Seminal Tract Epididymotomy, Decapsulation of the Epididymis, Epididymovasectomy, Epididymectomy, Epididymovasostomy, Vasotomy, Ligation of Vas Deferens, Seminal Vesiculectomy

THE EPIDIDYMIS

Surgical operations upon the epididymis consist of epididymotomy, for the relief of acute infection or the drainage of an abscess, epididymectomy most frequently done for tuberculosis of the epididymis but occasionally for chronic nontuberculous infection, and plastic operations (anastomosis of the vas deferens to the epididymis) for the relief of sterility

Acute Epididymitis

Surgical treatment is not often necessary in acute epididymitis With absolute immobilization of the testicle, the application of cold or heat (depending upon the stage of the infection), and the administration of some of the sulfonamide derivatives or antibiotics most cases are rather promptly relieved

When the acute infection is not relieved by this treatment or when pain and tenderness are severe *epididymotomy* or *decapsulation of the epididymis* gives rather prompt relief of pain and hastens resolution of the inflammatory process

Technique—After preparing the skin by washing with green soap and water and sponging off with alcohol an incision about two inches long is made near the lower pole of the scrotum The tissues are edematous and congested and there is considerable bleeding All bleeding points should be clamped and ligated before the tunica vaginalis is opened When this membrane is exposed and opened a moderate amount of fluid is usually evacuated The tunic is widely incised, exposing the swollen and congested epididymis The usual method of treatment is that advocated by Hagner Using a large needle, multiple punctures are made in the epididymis Serosanguinous or seropurulent exudate is obtained from the puncture wounds If an accumulation of pus is tapped a probe is inserted through the puncture wound and the tract is dilated to permit free drainage The pus cavity may be irrigated with an antiseptic solution I have found that stripping a portion of the visceral layer of the tunica vaginalis from the epididymis immediately releases the tension and permits free drainage When this is done the epididymis may be explored with a blunt probe

for pus pockets. Oozing from the epididymis is controlled by hot saline sheets, and definite bleeding points are ligated with fine plain catgut. A small rubber tissue drain is placed to the epididymis and brought out at the lower angle of the scrotal wound. The tunica vaginalis and the fascial coverings are closed loosely by a few interrupted sutures of fine plain catgut and the wound in the scrotum by interrupted sutures of medium silk. The drain may be removed in two or three days Because of the painful condition either a general anesthetic or spinal anesthesia must be used.

Tuberculosis of the Epididymis

Tuberculosis of the epididymis is usually associated with tuberculosis of the seminal vesicles and the prostate There is considerable controversy as to whether the disease occurs most often first in the epididymis or in the seminal

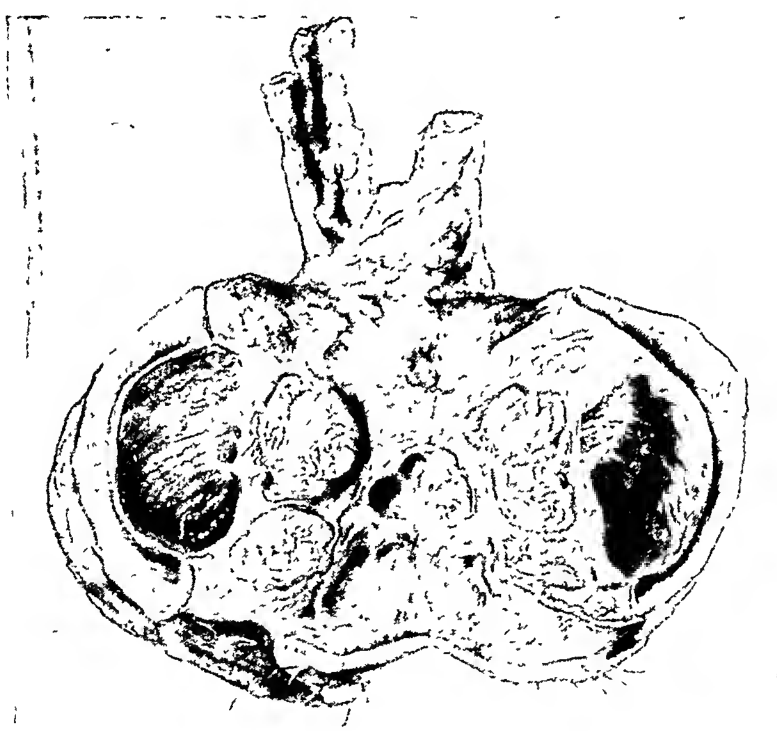

Fig 607 —Extensive tuberculous infection of left epididymis and testicle

vesicles. H. H Young who spoke of the disease as tuberculosis of the seminal tract believed that the early lesions are in the seminal vesicles and that in most cases the epididymis is secondarily involved. He advocated removal of the seminal vesicles, portions of the prostate when involved, the vas deferens and the epididymis. When the disease is unilateral he believed that the opposite epididymis did not often become involved following this treatment J. Dillenger Barney is foremost among those who believe that the disease usually begins first in the epididymis and that the lesions in the seminal vesicles and prostate will improve and frequently become quiescent when the epididymis

and the distal portion of the vas are excised It is not the province of this book to discuss further these views The majority of urologists practice the treatment advocated by Barney The more conservative surgical treatment will be discussed here, the more radical treatment with surgery of the seminal vesicles is discussed on pages 766 to 767

Genital tuberculosis is rarely if ever a primary disease The lungs, the kidneys or the bones are actively involved in most cases Sometimes several active foci can be recognized The prognosis therefore depends to a great extent upon the general condition of the patient and the activity of tuberculous lesions elsewhere The same hygienic and medical treatment that is advocated for other tuberculous lesions is essential Fortunately the operation of epididymectomy is not very trying on the patient It can often be done under local anesthesia and does not have to be postponed for a quiescent period or for general improvement in health as is desirable when more radical surgical operations are to be undertaken The frequency with which the testicle becomes involved early in the disease (Fig 607) and the opposite epididymis becomes infected offers further justification for epididymectomy whenever the disease is recognized It is the usual practice when excising a tuberculous epididymis to ligate the opposite vas deferens or excise the opposite epididymis even when it is normal This is justified because most patients with unilateral tuberculous epididymitis are sterile and recurrence in the supposedly normal epididymis is known to take place in approximately one third of the cases

Epididymovasectomy

The best results are obtained in this operation by following the principles of the operation described by Cabot, which include a careful dissection of the epididymis from the testicle, preserving the blood supply of the testicle and removing the vas deferens well above the internal ring In most cases the operation can be done under local anesthesia If the patient is apprehensive or there is acute inflammation spinal anesthesia is more satisfactory

The preparation of the skin should include the scrotum and the inguinal area The incision about two inches in length is made near the lower portion of the scrotum over the swollen area If there are sinuses or a fluctuating area that portion of the scrotum should be surrounded by an elliptical incision and removed with the epididymis The incision is carried down to the tunica vaginalis All bleeding points are clamped and ligated and the tunica vaginalis is opened If there are adhesions to the testicle they are carefully separated and the testicle and epididymis are delivered from the scrotum The epididymis is then dissected from the testicle from within outward with scissors (Fig 613) The dissection should keep close to the epididymis so that the vessels to the testicle which enter posterior to the epididymis will not be injured The vas deferens is then separated from the cord up to the external ring and all bleeding areas are clamped and ligated (Fig 608) Cabot treats the vas deferens in the following manner The vas deferens is doubly clamped and divided a short distance above the epididymis and the ends are carbolized The point of the clamp

for pus pockets. Oozing from the epididymis is controlled by hot saline sheets, and definite bleeding points are ligated with fine plain catgut. A small rubber tissue drain is placed to the epididymis and brought out at the lower angle of the scrotal wound. The tunica vaginalis and the fascial coverings are closed loosely by a few interrupted sutures of fine plain catgut and the wound in the scrotum by interrupted sutures of medium silk The drain may be removed in two or three days. Because of the painful condition either a general anesthetic or spinal anesthesia must be used.

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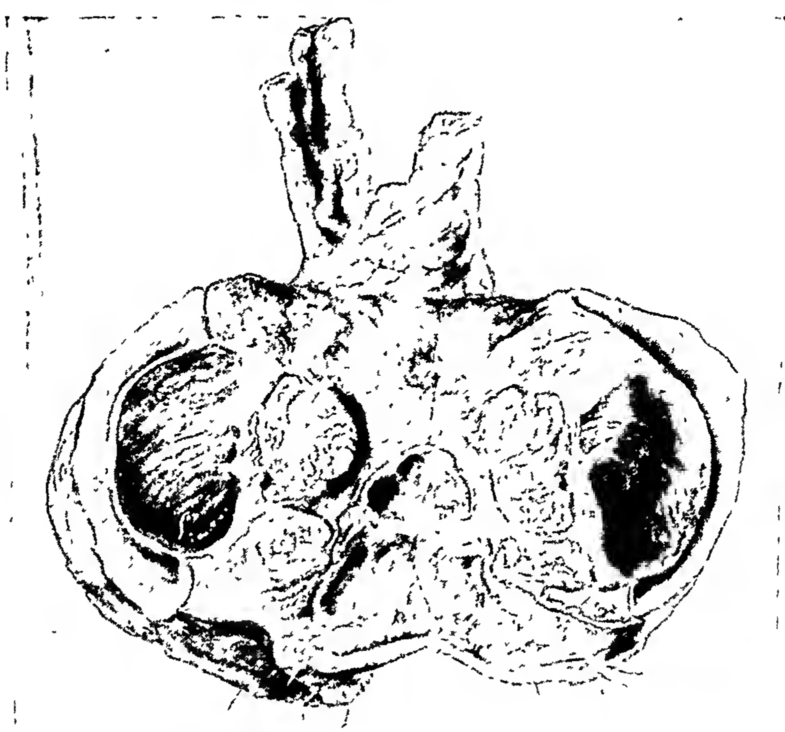

Fig 607—Extensive tuberculous infection of left epididymis and testicle

vesicles. H. H. Young who spoke of the disease as tuberculosis of the seminal tract believed that the early lesions are in the seminal vesicles and that in most cases the epididymis is secondarily involved. He advocated removal of the seminal vesicles, portions of the prostate when involved, the vas deferens and the epididymis. When the disease is unilateral he believed that the opposite epididymis did not often become involved following this treatment J. Dillenger Barney is foremost among those who believe that the disease usually begins first in the epididymis and that the lesions in the seminal vesicles and prostate will improve and frequently become quiescent when the epididymis

away and greatly delay convalescence If the dissection is carefully done, keeping close to the epididymis, the blood supply will be preserved Small superficial areas of tuberculous involvement may be curetted and painted with carbolic acid with a good chance of preserving the testicle If the involvement is at all extensive the testicle should be removed The slightest involvement may necessitate orchiectomy later When all bleeding has been controlled a wick of rubber tissue is inserted to the raw surface of the testicle and the wound in the scrotum is closed with interrupted mattress sutures of

Fig 603—Proximal end of vas held in grasp of curved hemostat is pushed through inguinal canal and made to emerge through a short incision over the internal ring The end is grasped by a second hemostat and as much of the vas pulled from the wound as possible ligated and divided The testicle is returned to the scrotum and the wound closed with drainage

silkworm gut A snug dressing is applied to the scrotum In about three days the drain may be removed, a well fitting suspensory applied and the patient allowed out of bed

Arthur B Cecil has described a very excellent method of exposing the testicle for the excision of a tuberculous epididymis, particularly when sinuses have occurred After the scrotum has been cleaned and the sinuses have been painted with pure carbolic acid the scrotum is seized and gentle pressure made above the testicle The testicle is pressed firmly against the area of the scrotum to be incised An elliptical incision surrounds the sinuses As the pressure

holding the upper end is guided into the external ring and carefully pushed along the canal until the tip of the forceps lies at the internal ring. The handle of the forceps is then depressed and an incision about half an inch long is made through the skin, fascia and aponeurosis of the external oblique, exposing the point of the hemostat The end of the vas deferens is identified and grasped by another hemostat (Fig. 609) and the original hemostat is withdrawn. The vas is gently pulled upon and separated from the inguinal portion of the cord until the remaining portion extends vertically into the wound. By continuous traction and finger dissection through the short inguinal incision as much of the vas as possible is withdrawn. It is then clamped

Fig. 608.—Excision of epididymis for tuberculosis Vas deferens isolated from the cord, doubly clamped, and divided

deep in the wound, ligated and divided. The ligated end is carbolized and permitted to drop back. The inguinal wound is closed by a single catgut stitch in the aponeurosis and a silk or silkworm stitch in the skin.

The testicle which has been covered by warm moist gauze while the vas deferens was being removed is now carefully examined for evidence of injury to its blood supply and tuberculous involvement. If the spermatic artery has been divided the testicle will be pale and soft and there will be no bleeding when the tunica albuginea is pricked with a sharp-pointed knife. If this is so there is little advantage in leaving the testicle. It will gradually slough

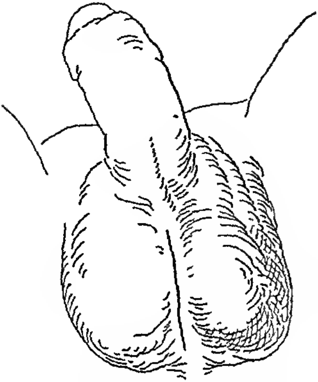

Fig 610 — Scrotal incision for exposure of either testicle Fewer and smaller blood vessels are encountered in this area

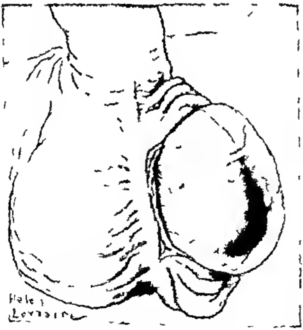

Fig 611 — The scrotum and scrotal fascia have been dissected from the tunica vaginalis

above the testicle is maintained the fascial coverings of the testicle are divided to the tunica by light concentric elliptical cuts. The incisions dividing the fascia are kept close to the central portion of skin so that a thick scrotal wall will be maintained. If abscesses are encountered they are avoided by making the dissection slightly further out. All bleeding points are clamped and ligated. As the fascia is divided the testicle and epididymis are gradually extruded from the scrotum. The scrotum which has not been contaminated is isolated from the testicle by moist gauze. Moist gauze sheets are placed beneath the testicle, the tunica vaginalis is opened and the epididymis is dissected from the testicle. When there is no sinus present the testicle is extruded through the lowest portion of the scrotum and the scrotum is pushed back like a cuff. When the epididymis has been removed the scrotum is pulled down over the testicle and the wound closed with interrupted dermal sutures without drainage.

Cecil treats the vas deferens in the following manner: When the epididymis has been separated from the testicle, both the testicle and epididymis are wrapped in moist gauze and set aside. A clamp is pushed up along the cord until its tip reaches the external ring A short incision is made over the tip of the clamp and another clamp is passed down along the same path as the first clamp, which is withdrawn. The vas deferens is grasped with the tip of the second clamp and after being clamped below is divided between the two clamps. The stumps are thoroughly carbolized. The clamp and the vas are then drawn upward bringing the vas out of the incision over the external ring The clamp is not removed from the vas nor is the vas ligated for fear of contaminating the wound. A single stitch is taken in the small incision and tied around the vas. The clamp with the vas fastened in it is wrapped in gauze and strapped to the abdomen. The vas usually comes away at the skin level in seven or eight days; if not, it is ligated at the skin level, which causes it to slough away.

In acute tuberculosis of the epididymis Keyes advises curettage and marsupialization of the tuberculous area. A portion of the scrotal wall including the fistulous tracts is excised over the tuberculous area. The tunica vaginalis is opened and partly excised All tuberculous foci are thoroughly curetted. The margins of the skin are then sutured to the margins of the tuberculous surface. An ulcer is thus formed which may be months in healing. Keyes states that he has done this operation many times without losing a testicle and without generalization of tuberculosis or wound complications. A secondary operation may be done later to remove the remainder of the epididymis and a portion of the vas. This operation is obviously indicated only when there is little possibility of removing the epididymis without gross contamination of the wound or destroying the blood supply of the testicle.

Chronic Nontuberculous Epididymitis

Chronic epididymitis usually is controlled by a well-fitting suspensory and the elimination of the causative factors, such as infection of the prostate and seminal vesicles and urethral strictures. Some cases of persistent infec-

tion with frequent acute exacerbations are relieved by ligation of the vas deferens. When the epididymis remains swollen and tender regardless of the more conservative methods of treatment *epididymectomy* should be done. The operation is the same as that described for tuberculosis of the epididymis except the treatment of the vas deferens. This may be ligated and divided just above the epididymis (Figs. 610-613).

Inflammatory Occlusion of the Epididymis or Vas Deferens

Epididymovasostomy.—Bilateral inflammatory occlusion of the epididymis or vas deferens is one of the most frequent causes of sterility in the male. In epididymitis the healing process leaves scar tissue which occludes the efferent ducts of the epididymis, preventing egress of spermatozoa from the testicles. The occlusion is usually complete in the tail of the epididymis where there is only one efferent duct. In the globus major the ducts are numerous; consequently it is unusual that they are all occluded. A cure may be obtained in some cases by anastomosing the vas deferens above the occluded area to the globus major of the epididymis as suggested by Edward Martin, of Philadelphia, a pioneer in this field.

The operation should not be done when there is evidence of active infection of the seminal vesicles or urethra or when there is a urethral stricture. The patency of the vas deferens from the point of anastomosis to the prostatic urethra should be determined before the anastomosis is made. Careful palpation of the vas will demonstrate areas of beading or thickening, which indicate areas of occlusion. The patency of the tube can be determined by injecting a few cubic centimeters of a weak aqueous solution of methylene blue through the vas and noting its appearance in the urine.

Before the operation is begun a small catheter is inserted through the urethra and clamped to prevent complete emptying of the bladder. It is secured to the penis by adhesive to keep it in place. The scrotum is prepared and an incision made in the raphe. Both testicles are exposed through the same scrotal incision. The incision is continued through the fascia and tunica vaginalis of the testicle to be exposed first. The testicle is delivered from the scrotum and the epididymis examined. In favorable cases the globus major has a rather full feeling on palpation. If it is small and contracted or indurated the tubules may be all obliterated by fibrous tissue and no spermatozoa discoverable. The lower portion of the vas deferens is liberated, being careful not to strip it too close. An area of the vas that can be easily approximated to the globus major is selected and an incision made into the lumen about a half centimeter in length. With a syringe equipped with a small blunt needle the methylene blue solution is injected slowly through the vas. If the vas is patulous the solution can be injected without difficulty. The clamp is removed from the catheter. If the vas is patent the dye will appear in the urine. If this test shows obstruction in the vas an opening may be made at a higher level. If the occlusion in the vas is too high to permit an anastomosis the operation is abandoned on that side. If the vas is patent

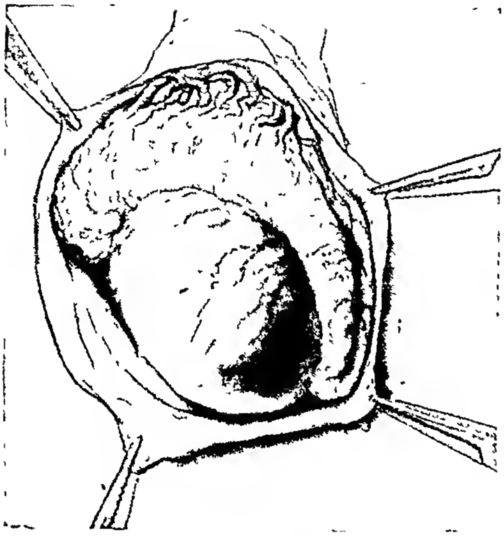

Fig 612

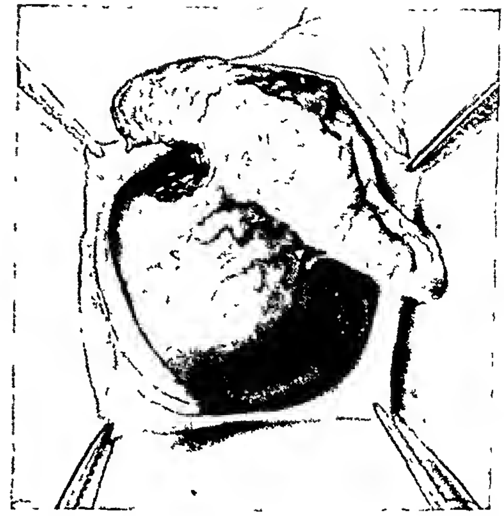

Fig 613.

Fig 612 —The tunica vaginalis has been divided, exposing the testicle and diseased epididymis

Fig. 613 —Excision of the epididymis The two poles of the epididymis have been dissected from the testicle

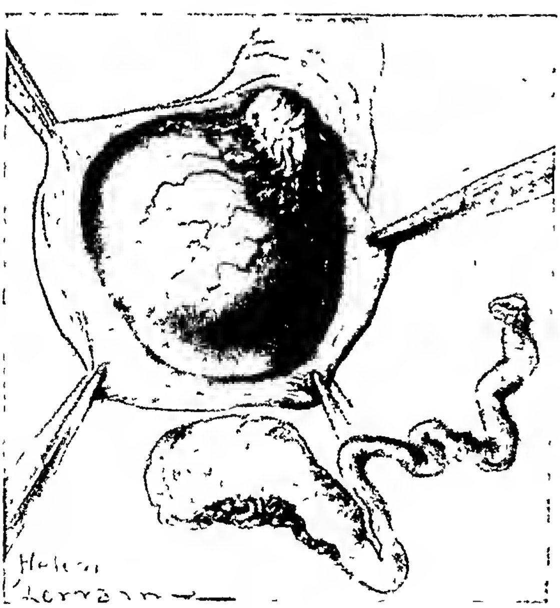

Fig 614

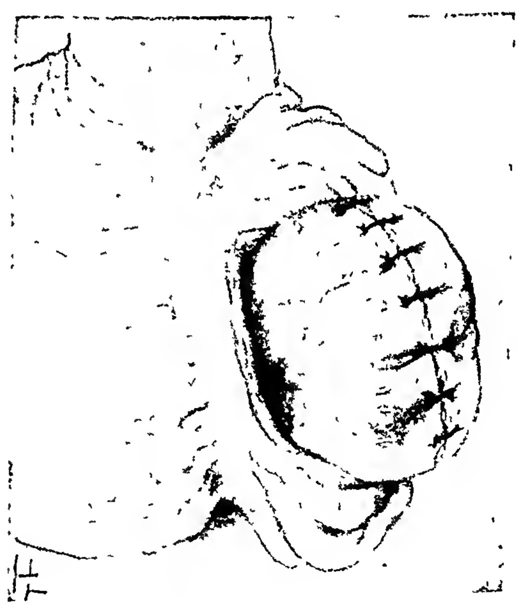

Fig 615

Fig 614 —The excision is complete, including a portion of the vas deferens In tuberculous cases the vas should be removed to the inguinal canal and the proximal end fixed to the surface of the skin through a stab wound

Fig. 615 —The tunica vaginalis is sutured over the testicle The scrotum is closed and a small rubber tissue drain is placed down to the tunica vaginalis

the sutures had been placed. When the four silver wire sutures have been inserted the ends are carefully twisted together thereby completing the anastomosis. The ends of the sutures are then cut off close to the wound. In Hagner's experience no cases were successful except those in which silver wire was used. He attributed this to the small amount of tissue reaction produced by the silver sutures.

If spermatozoa are found on both sides a bilateral operation should be done to increase the probability of success. If spermatozoa are found only

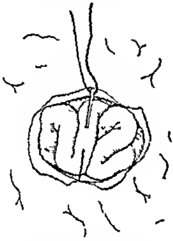

Fig 617

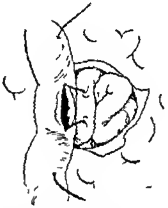

Fig 618

Fig 617.—The operation of Lespinasse for anastomosis of the vas and the epididymis. A fine silk suture is inserted into a tubule of the epididymis.

Fig 618.—The suture in the tubule is carried through the incision in the vas as explained in the text. (Lespinasse.)

Fig 619.—The other sutures are placed to hold the vas to the capsule of the epididymis. (Lespinasse.)

on the side of an occluded vas deferens, the opposite vas, if patent, may be brought through the septum of the scrotum and anastomosed to the epididymis containing spermatozoa.

V. D. Lespinasse, of Chicago, devised an operation which is a direct anastomosis between the epididymis tubule and the vas. An incision is made in the scrotum and through the tunica vaginalis. The epididymis is exposed and the point of obstruction is found. The vas is opened by a short longi-

an elliptical incision is made in globus major of the epididymis by pinching up a small portion with small rat tooth forceps and snipping it off with a pair of curved eye scissors A small amount of blood-tinged yellowish fluid will appear on the surface of the wound. This fluid is immediately examined under the microscope. If no spermatozoa are found other incisions are made in the epididymis until spermatozoa are found or until the entire area is proved sterile. If sperm are found a lateral anastomosis is made between the vas deferens and the epididymis. Hagner, who was quite successful in the surgical treatment of sterility, used very fine silver wire to suture the incision in the vas to the incision in the epididymis. The first suture is placed at the distal end of the incision in the vas. A heavy bite is taken and the vas is

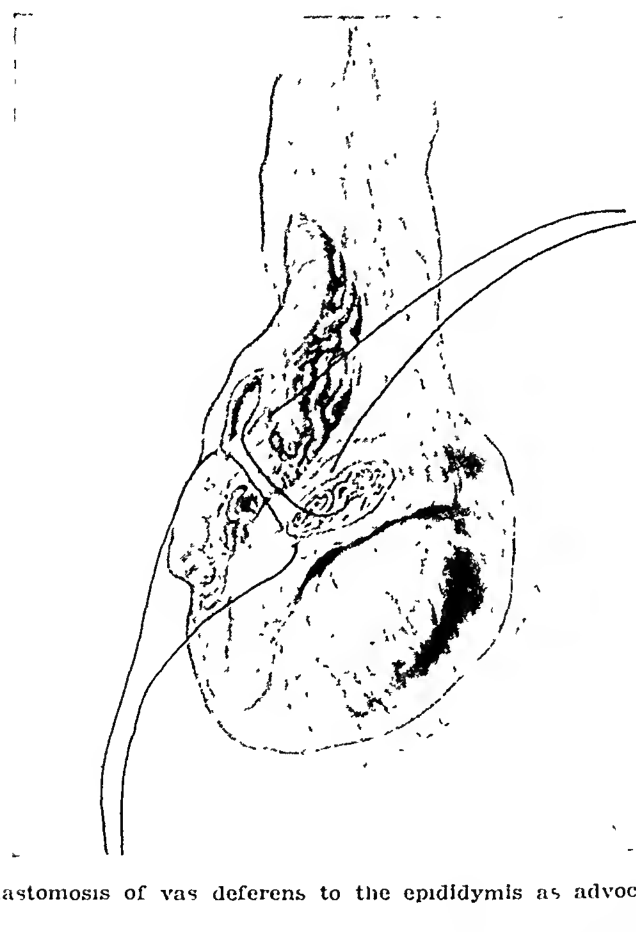

Fig 616 —An anastomosis of vas deferens to the epididymis as advocated by Hagner

securely anchored to the lower end of the incision in the epididymis The two lateral sutures take a fairly deep bite into the epididymis, including some of the cut tubules. This prevents the cut tubules from dropping back when the anastomosis is made (Fig. 616). When the lateral sutures are passed through the cut edges of the vas the bite should be just deep enough to hold and approximate the edges. The last suture in the upper angle of the wound also takes a fairly deep bite in the epididymis and is passed very carefully through the upper angle of the incision of the vas so as not to occlude its lumen. Hagner used a tear duct probe to test the patency of the vas when

the sutures had been placed When the four silver wire sutures have been inserted the ends are carefully twisted together thereby completing the anastomosis The ends of the sutures are then cut off close to the wound In Hagner's experience no cases were successful except those in which silver wire was used He attributed this to the small amount of tissue reaction produced by the silver sutures

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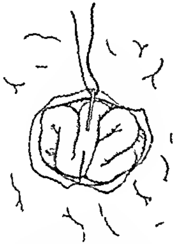

Fig 617

Fig 618

Fig 617 —The operation of Lespinasse for anastomosis of the vas and the epididymis A fine silk suture is inserted into a tubule of the epididymis

Fig 618 —The suture in the tubule is carried through the incision in the vas as explained in the text (Lespinasse)

Fig 619 —The other sutures are placed to hold the vas to the capsule of the epididymis (Lespinasse)

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tudinal incision and a colored fluid, as methylene blue, is injected into the central end of the vas If the fluid appears in the urethra it is a demonstration that the vas is open from the point of incision to the urethra and the operation can be proceeded with. If the vas is not open the operation, of course, will be abandoned unless the point of occlusion can be found farther up. If the operation is to be completed the capsule of the epididymis above the obstruction is carefully incised down to the tubule. All of the layers of the capsule are removed from the epididymis tubule with great care and the epididymis tubule itself should not be injured or opened at any point. It protrudes through the opening thus made and a loop of the tubule is selected whose direction is in the long axis of the body of the epididymis. A suture of fine arterial silk (00000) on a No. 19 bayonet-pointed needle is passed through the wall of the epididymis tubule, down its lumen, and out again through the wall of the tubule about three mm. from the point of entrance (Fig. 617). This is followed by leakage of epididymal secretion which is drawn into a small syringe and examined for spermatozoa If spermatozoa are present this suture is passed through the incision that has been previously made into the vas and out through its wall. The other end of the suture is threaded into a needle and passed through the wall of the vas in a similar manner at the other end of the incision in the vas In this way the epididymis tubule is drawn into the longitudinal incision in the vas (Fig 618). Sutures of catgut are placed on each side of the longitudinal incision in the vas, include the full thickness of the wall of the vas, and are carried to the capsule of the epididymis These hold the incision in the vas open Two other sutures are placed into a portion of the wall of the vas but do not penetrate to its lumen or epithelial lining and hold the vas to the capsule of the epididymis a short distance from the ends of the longitudinal incision into the vas (Fig 619). When these two sutures are tied they should leave the intervening segment of the vas without tension so that the union between the vas and the epididymis tubule is in accurate approximation and without strain The upper end of the original suture is threaded on a long Hagedorn needle and after the testicle has been replaced in the scrotum the needle pierces the scrotum from within outward In from one to two weeks when the wall of the epididymis tubule within the grasp of this suture has become cut by this suture it is gently removed.

VAS DEFERENS

Operations upon the vas deferens consist of partial or complete excision, vasotomy, and ligation. Excision of the vas is discussed with operation upon the seminal vesicles and the epididymis

The vas deferens is readily exposed in the upper portion of the scrotum by isolating and approximating it to the skin with the thumb and forefinger (Fig 620) and making a short longitudinal incision through the skin, fascia and dartos, exposing the vas If one prefers, a large curved needle may be passed through the scrotum beneath the vas to steady it. After the vas is exposed, it is freed by blunt dissection and brought into the wound It may then be incised or divided and ligated, according to indications The vas is usually incised for the purpose of inserting a needle to irrigate the seminal vesicle, according to

the method popularized by Belfield for the treatment of seminal vesiculitis. In this method of treatment after the needle has been inserted either through an incision or by puncturing the vas (which is more difficult), a fine horsehair or silkworm gut suture is passed through the needle and the proximal portion of the vas to determine its patency. The horsehair or silkworm gut is withdrawn and the antiseptic solution is then injected through the vas, a portion of it regurgitating into the seminal vesicle. Some operators leave the needle in place several days for repeated irrigations. This operation is beneficial in many cases of seminal vesiculitis, though it carries the risk of occluding the lumen of the tube.

Vasotomy may be done to determine the patency of the tube, and this is carried out as described here, or by gently injecting through the vas a colored solution to be expelled from the bladder. Ligation of the vas is occasionally

FIG. 620.—Vasectomy for the production of sterility. The ends of the vas are sutured to different fascial planes.

done for the treatment of recurrent epididymitis and as a means of birth control, and frequently for the prevention of epididymitis following prostatectomy. The vas is doubly ligated and divided between the ligatures. It is a good practice to use the ends of the ligatures to fix the divided ends to the extremities of the scrotal wound. The wound in the scrotum is closed with one or two interrupted sutures of silk or silkworm gut and a small gauze dressing is fixed in place by collodion or held on by a suspensory.

When the vas deferens is divided and ligated for the purpose of sterilization one or two centimeters should be excised and one end sutured external to the fascial coverings of the cord so that there will be no possibility that the lumen will become re-established (Fig. 620, A).

THE SEMINAL VESICLES

Disease of the seminal vesicles may require operation for drainage or, occasionally, for excision of the seminal vesicles. In either case the technique of exposure of the vesicles is the same. The patient is placed in the exaggerated perineal prostatectomy position, and an incision is made similar to that used in perineal prostatectomy. The operation proceeds as in perineal prostatectomy, with blunt dissection on each side of the central tendon and division of the tendon and the rectourethralis muscle. The membranous urethra and apex of the prostate are now exposed. The urethra is not opened as in prostatectomy, but the prostate and vesicles are pulled forward by a double tenaculum hooked into the base of the prostate, or by Young's long urethral retractor. A sound or Young's long urethral retractor is inserted into the urethra.

The fascia that covers the apex of the prostate is divided and stripped back by blunt dissection, together with fibers of the levator ani muscle which are attached to the base and lateral surfaces of the gland A double tenaculum is now inserted into the base of the prostate for retraction, or if Young's retractor is used, the blades are opened and the handle pulled forward and upward to bring the seminal vesicle area into view. By blunt dissection the rectum is freed well behind the prostate, exposing the vesicle area and the base of the bladder. The rectum is protected by a gauze pad and held back by a long, flat right-angle retractor, about 1½ inches wide. Narrow retractors in the sides of the wound will aid the exposure. As the prostate is pulled forward Denonvilliers' fascia is divided near the base of the gland and stripped away by blunt dissection, exposing the vesicles and the vas deferens The vesicles may now be excised or drained If there is not too much exudate or adhesions, they should be separated from the vas deferens and base of the bladder, ligated at the base of the prostate and removed. If the vas is thickened or the ampulla dilated, it should be incised and drained When exudate and adhesions prevent excision of the vesicles, their posterior walls are trimmed away with scissors, leaving the anterior walls attached to the bladder; or if preferred, the posterior walls may be incised throughout their entire length. If the vesicles are incised or the posterior walls removed, small, soft rubber tubes with many perforations should be sutured to the remaining vesicle walls. If the vesicles are removed, the tubes should be secured to the vas deferens If necessary, the prostate may be incised and drained, or partly removed, at the same time, but the bladder or urethra should not be entered if it is possible to avoid it. Before the wound is closed, the base of the bladder, the peritoneum in the depth of the wound, and the rectum should be carefully examined, and if injured, should be immediately repaired. The wound is closed by suturing the levator ani muscles together below the drainage tubes which are brought out at one angle of the wound The divided rectourethralis and the central tendon are sutured with chromic catgut and the superficial fat and skin with interrupted sutures of silkworm gut. A firm dressing is applied

H H Young advised excision of the seminal vesicles, ampullae and lower portion of the vasa deferentia and the lateral lobes of the prostate through the perineum for the treatment of tuberculosis of the seminal tract At the same operation the remainder of the vas deferens, epididymis and testicle (if involved) are removed through the groin or scrotum

The operation for excision of the seminal vesicles is similar to the operation just described except that the lateral lobes of the prostate, the ampulla and as much of the vasa deferentia as can be reached are removed with the seminal vesicles Clamps are left on the stumps of the remaining portion of the vasa and two narrow strips of iodoform gauze are inserted into the deepest portion of the wound but the perineal wound is not closed until the diseased epididymis and remaining portion of the vas are removed

After removing the epididymis (or testicle), traction is made on the vas deferens and it is liberated from the other structures of the cord to the internal ring by inserting the finger through the external ring and following the course of the vas deferens back to the peritoneum The vas is further liberated by to and fro traction of the clamp attached to the deeper portion and the vas grasped with gauze externally The clamp is then removed and the vas withdrawn by traction on the external portion

If the opposite epididymis is involved the same operation is carried out on that side If no operation is done on the other epididymis as much of the vas as possible is divulsed and removed with the ampulla

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CHAPTER XLII

ENDOCRINOLOGY AND ENDOCRINE THERAPY OF THE PROSTATE

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While the prostate itself elaborates no specific hormone, it is the object of an interplay of endocrine influences which have a far-reaching significance. The testes, the pituitary, and adrenals affect especially the development, growth, and size of the prostate gland Also they seem to have a definite but not too clearly defined influence on its regressive changes in senescence and its hyperplastic manifestations, and to modify the growth and development of its neoplastic diseases

The Testicular Hormones

Following McGhee's isolation of an active lipoid-soluble male sex hormone from the bull's testes in 1927, Butenandt, Ruzicka, and others isolated androsterone, dehydroandrosterone and testosterone. Subsequently the relation of these substances to cholesterol and their synthesis from this chemical was established. It is now believed that testosterone is the true male hormone, androsterone and dehydroandrosterone being less active metabolic derivatives found in urine.

It had been known that castration in lower animals was followed by atrophy of the prostate and seminal vesicles When androsterone was isolated, it was found by biologic assay that virility, sex vigor, and the occurrence of prostatic hypertrophy in later life appeared concomitantly with a diminution of androsterone in the urine. Moore and Miller noted an especial decrease in older men with prostatic hypertrophy. Hence the initial but somewhat erroneous assumption was made that these phenomena of senescence were due to a decrease in male sex hormone function.

The Pituitary Hormone

Hoskins in 1911 had developed the concept that the gonadotrophic activity of the pituitary was normally held in check by the gonads Smith and Engle showed that hypophysectomy in animals caused atrophy of the prostate, and Walsh, Cuyler and McCullagh found that such posthypophysectomy prostatic atrophy in rats could be prevented by daily administration of male sex hormones. Also it was noted by Korenchevsky, Nelson, Gallagher and others that castration

†Deceased

was followed by alteration of secondary sex characteristics, hypertrophy of the pituitary with the formation of peculiar vacuolated cells in the basophilic elements (the so called signet cells or castration cells), and hypertrophy of the adrenals. Such changes could be prevented by administration of male hormone in large amounts or of lesser amounts of male hormone and extremely small amounts of estrogen.

From female endocrinology it had been established that there are two gonadotrophic hormones in the anterior pituitary gland, one producing follicle stimulation, the other producing luteinization. In the male, evidence is accumulating to show that the follicle stimulating hormone activates the seminiferous tubule to produce sperm, while the luteinizing pituitary factor stimulates the interstitial cells of Leydig to elaborate the androgenic hormone, which in turn stimulates the development of secondary sex characteristics.

Following the work of Meyers, Vidgoff and Hunter, who somewhat paradoxically produced atrophy of the prostate by feeding rats with desiccated beef testes, Lower and McCullagh, from experimental evidence, developed the concept that the testis has two major hormones. One, inhibin, a water soluble hormone, developed in the tubules or the germinal cells, inhibits or depresses the gonadotrophic activity of the pituitary from overstimulating the interstitial cells of the testis. The other, androitin, is produced by the interstitial cells of the testis. Androitin, closely related to androsterone and testosterone, acts as a sex stimulant and in excess produces prostatic hypertrophy. The Lower theory, simply stated, is that after middle age regressive changes in the germinal cells of the testis lessen the elaboration of the pituitary depressing inhibin. The overactive pituitary then stimulates an overproduction of so called androitin (male hormone) with consequent prostatic hypertrophy. It had been noted before that parenteral injection of the anterior pituitary like principle of pregnancy urine would produce prostatic enlargement in castrated rats and monkeys. Whether or not this enlargement is similar to prostatic hypertrophy in man is a matter of dispute. However the Lower theory has not been accepted. There is neither enlargement of the pituitary in benign prostatic hypertrophy in man nor are histologic changes noted; there is no prostatic hypertrophy in teratomas of the testis where large amounts of circulating substances similar to pituitary gonadotrophic hormone are present; there is no consistent finding of increased urinary excretion of significant amounts of either gonadotrophic substances, male hormone or estrogen in patients with prostatic hypertrophy.

Estrogen or female sex hormone now enters the picture. Zuckerman showed that male and estrogenic hormone are both elaborated in the male organism. He felt that they are balanced in such proportion that the estrogenic powers of the female sex hormone are ordinarily inhibited. Senescence disturbs this balance. Wugmeister in 1937 advanced the idea that the female hormone diminishes in later life in both male and female whose organisms tend toward hypervirilation." The anterior pituitary, being no longer inhibited by estrogen, overstimulates the testis to elaborate an excess of androgen and thus stimulates the genital apparatus to hypertrophy.

Further concepts of estrogen-androgen imbalance as a cause of prostatic and genital changes were numerous. Zuckerman and Parkes produced prostatic enlargement in castrate monkeys by estrone injection and counteracted it with injections of testosterone. The enlargement is due to an increase in the fibromuscular elements, with hyperplasia and metaplasia of the ejaculatory ducts, prostatic collecting tubules, the epithelium of the urethra and vagina masculina. The epithelium of the true prostatic glands did not change Geschickter by injecting testosterone restored the prostatic epithelium and hypertrophy of the seminal vesicals in monkeys whose prostates had undergone atrophy from castration. Lacassagne, Burrows and others demonstrated that administration of estrogens to mice produced metaplasia of the prostatic epithelium (a common finding in prostatic hypertrophy) Van Cappellen, Burrows and Zuckerman concluded that large amounts of estrogen acting during presenility would cause enlargement of the prostate. If true, large doses of androgen should prevent and relieve prostatic hypertrophy. However, Moore, McClellan and others found that injection of testosterone in large doses resulted in no significant restoration of the involuted prostate of presenility or in the histologic appearance of the benign hypertrophied prostate. While injection of estradiol benzoate produces conspicuous alteration in the urethral and ductal epithelium, there is little if any change in the tissues of benign hypertrophy. However, Huggins has demonstrated that injection of testosterone restored not only the size but the secretory activity of atrophied prostates of dogs following castration.

Again showing how conflicting the evidence may be when different workers deal with different species under varying conditions, we may cite Korenchevsky and Dennison who produced prostatic atrophy in normal rats with estrone and prostatic hypertrophy in castrated rats with the same female hormone; Deming and co-workers' demonstration of prostatic hyperplasia in a male macaque monkey with estrone; a converse observation of hypertrophy of the rudimentary prostatic analogue in female mice with testosterone but not with estrone. This evidence supports the view that overbalance of female hormone in males and of male hormone in females might produce hypertrophy of the prostate or of its contrasexual homologue in certain animals. Wattenberg and Moore note that the utricle and prostatic urethra are homologous to the female vagina. They found that the clinical use of estrogens produced squamous hyperplasia of these structures, such as have been noted experimentally in mice and monkeys

In general, the experimental evidence of hormonal relationship to prostatic enlargement is confusing and highly controversial. It has been of value, however, in suggesting certain avenues of approach to the clinical use of hormones in therapy.

The Nature of Prostatic Enlargement

Deming and co-workers from histologic studies contend that the components of the prostate gland responsible for benign enlargement are the muscle fibers (originally from the lower Müllerian tube) and the prostatic ducts. The process begins as a solid fibromuscular mass of Müllerian tissue in the muscular wall of the prostatic urethra. This mass stimulates an epithelial proliferation of the ducts. The primary tumor is then invaded by the duct epithelium which forms

glandular tissue and grows more rapidly than the stroma. Hence the mass may appear wholly glandular. The glands of Albarran and the glands of the posterior and lateral lobes are not involved in the early phases of development. Thus benign enlargement is a hyperplasia and not a hypertrophy of tissue. They compare this with the growth of uterine myoma and note that hypothetically they have a common anlage. The hyperplastic growth causes compression atrophy of normal prostatic tissue which is displaced laterally by the growing adenomata. These authors contend that hormone therapy does not affect the hyperplastic tissue and does not cause regressive changes in the normal prostatic tissue which is already atrophied by compression.

The Incidence of Benign and Malignant Prostatism

In 35 to 50 per cent of men over 50 years some hyperplasia of the prostate is noted. A variable number, from 20 to 30 per cent, of these will require treatment for obstruction. The incidence of cancer as a histologic finding is impressive. In 1935 Rich noted 41 cases of prostatic cancer in 252 autopsies in men over 50 years (16 per cent). Moore in 1935 observed cancer in 262 prostates from patients, none under 44 years: 17 per cent from 41-50 years, 14 per cent from 51-60 years, 23 per cent from 61-70 years, 21 per cent from 71-80 years and 29 per cent from 81-90 years. Baron and Angrist found histologic evidence of cancer (occult adenocarcinoma) in 46 per cent of 50 prostates studied by serial sections. The prostates were from unselected consecutive autopsies in men over 50 years. Metastases were not noted. In general the incidence of hypertrophy was three times that of cancer.

Carcinoma of the prostate is frequently associated with benign hypertrophy but probably arises independently of it. In about 75 per cent of the cases the disease begins in the posterior lobe, which is almost never the seat of benign hyperplasia. Adenocarcinoma, medullary, scirrhus and even squamous celled varieties are found and may frequently be associated in the same gland. The growth of prostatic cancer is insidious and variable. Certainly we do not see carcinoma of the prostate clinically in the same degree of frequency that is noted histologically at autopsy or especially in serial sections of glands removed at autopsy. Sarcomas of the prostate are exceptionally rare. While they may occur at any age, most cases are encountered in youth.

Clinical Use of Hormone Therapy in Benign Prostatism

Male hormone therapy, chiefly testosterone, has been widely used for benign prostatic hypertrophy. Walther and Willoughby reported 15 cases so treated with temporary clinical improvement. Day, Cary, Boland and others reported similar cases which responded clinically to testosterone but no changes in size were noted by cystoscopy or by rectal palpation. Heckel was not impressed with the use of testosterone in prostatic hypertrophy but did find that oligospermia resulted from continued large doses.

On the whole the use of the male hormone has not been satisfactory. It may act at times by inhibiting the pituitary or by stimulating the musculature of the bladder (Kearns) to greater propulsive activity or perhaps by exciting

indirectly the adrenal cortex to activate steroidal hormone influence on the prostate. It may also supply an androgenic deficiency, counterbalance an estrogenic excess, thus restoring a theoretical androgen-estrogen imbalance *It must be remembered in considering the effects of all hormone therapy that benign low-grade prostatic obstruction normally is associated with periods of regression.* Some authors find that the effects of testosterone therapy are no better than those achieved in a parallel series of cases when injections of saline are given (Draper). Certainly no specific changes in size of the gland or regressive histologic changes in its tissues by biopsy have been noted.

The use of estrogens in treating benign hypertrophy, however, cannot be dismissed so quickly. With Huggins' introduction of antiandrogenic therapy in prostatic cancer there also arose much popular interest in the hormone therapy of treating benign hypertrophy. Huggins, Stevens and Hodges subjected 3 patients with benign hypertrophy to castration. This was followed by epithelial atrophy together with gross decrease in the size of the gland as revealed clinically and by biopsy specimens They felt that as old age approaches there is a decrease in the male hormone, yet enough hormone remains to produce prostatic hypertrophy. However, if this residuum of hormone is eliminated or reduced by castration, the prostate will atrophy Also by the administration of estrin without castration the remaining male hormone is neutralized and atrophy similar to that produced by castration takes place.

Estrogens, chiefly diethylstilbestrol, have been widely used during the past ten years Kahle and Maltry, Kittridge, Klein and Newman have noted a fairly high degree of clinical improvement in a variable percentage of cases thus treated In some instances the size of the prostate noted by cystoscopy and rectal examination was definitely diminished and biopsies showed regressive changes in the prostatic tissue On the other hand, Pierson, by roentgenographic measurements of the prostate in 13 patients with retention of not over 3 ounces, noted a variable diminution in the size of the prostate, averaging about 7 mm. in 10 cases after treatment with daily small doses of stilbestrol He felt that the shrinkage was not great enough to warrant this therapy except in unusual cases

Keyser reported successful clinical results from the use of estrogen therapy in 41 patients with borderline prostatic obstruction, i e, with weak stream, dribbling and nocturia, but little residual However, in another group of 21 patients of similar type, estrogen therapy seemed of little value In 58 patients with larger glands and higher degrees of obstruction (residual urine over 3 ounces) estrogen therapy, while occasionally attended by brilliant results, was not on the whole satisfactory. Many patients improved temporarily but later had recurrence of obstruction which required surgery. Nine patients who for various reasons required suprapubic cystostomy were given large doses of estrogen Their sinuses closed and remained closed The patients voided well and had little or no residual urine Another group of patients (about 20 in number) were placed on indwelling catheter drainage. After estrogen therapy such reduction of residual, increased force of stream, and general well-being followed that operation was refused.

Diethylstilbestrol in doses of 1 to 20 mg or even more daily by mouth or by injection has been the drug most used. The optimum dosage being unknown, the author recommends starting with 5 mg daily, increasing or decreasing the dosage to the patient's tolerance. The drug has certain hazards, viz., nausea (a very frequent finding), dizziness, edema of the lower extremities, and an erythematous skin rash, at times leading to exfoliative dermatitis. Loss of libido and oligospermia result from large doses and must be considered in treating younger men or older ones who are sexually active. Painful engorged breasts occur in a large proportion of cases on prolonged therapy or with larger dosage. Stopping stilbestrol and administration of testosterone may relieve this breast engorgement. However, testosterone does not entirely neutralize estrogen effect nor has the exact quantity of the dosage needed to depress estrogen action been determined.

Premarin, estradiol benzoate and Estinyl have been used with variable result when diethylstilbestrol has not been tolerated. Estinyl in dosage of 0.05 to 0.5 mg daily has seemed most effective in several instances when given over periods of ten days and repeated after an interval of rest.

In summary, estrogen or androgen therapy is no substitution for surgery in patients with well developed prostatic obstruction. *The accurate evaluation of hormone therapy becomes most difficult when we remember that prostatism frequently regresses and symptoms subside for long periods of time when local measures such as massage, diathermia, drainage or even no therapy are applied.* Nevertheless hormone treatment, especially with estrogens, appears to be of value in borderline cases with small residual and soft glands. It may be tried with occasional success in larger obstructive glands. If after one to two weeks' treatment no sharply defined and obvious improvement is obtained, resection or prostatectomy is in order.

Endocrine Therapy in Prostatic Cancer

The application of endocrine therapy by Huggins and Herbst to the treatment of prostatic cancer is one of the outstanding contributions to modern science. It marked the first signal response of malignant disease to chemotherapy. We may state the concepts developed by this work as follows. The histogenesis of prostatic carcinoma is not altogether autonomous. These neoplastic cells are stimulated by androgens from the testis and to a lesser degree from the adrenals. The effort to eliminate or reduce to a minimum this androgen stimulation has been carried out (1) by surgical castration, (2) by castration with x-ray irradiation, (3) by administration of estrogens with or without castration to neutralize or depress androgen, (4) by adrenalectomy or adrenal irradiation to eliminate a secondary source of androgen formation after castration and (5) by pituitary irradiation as a means of suppressing pituitary stimulation of androgen elaboration.

Prostatic cancer cells freed from androgen stimulation undergo retrogressive change. Decrease in size of nuclei, condensation of nuclear chromatin, absence of nucleoli, clearing of the cytoplasm, rupturing of cell membranes with coalescence of vacuoles, with ultimate clustering of pyknotic nuclei and frag

ments of cells in the center of acinar spaces, have been noted (Kahle, Shenken and Burns). All the cells do not die but after a variable period of time they resume a recurrent but frequently decreased activity.

Estrogen inhibits pituitary activity, depresses the germinal epithelium of the testis, and, to a variable degree, neutralizes the male hormone or diminishes its elaboration. Excessive estrogen administration may produce carcinoma of the breast in male mice. The possibility of such a result in the human male and female has been suggested

Significance of Serum Phosphatase

Huggins found that the serum acid phosphatase was usually elevated above the normal (3 to 5 King Armstrong Units) in advanced prostatic cancer, especially if bone metastasis is present The neoplastic epithelium itself showed large amounts of this enzyme as determined by specific staining methods. Acid phosphatase present in traces in the prostate of infants is found in large amounts in normal adult and hypertrophic glands It is even more abundant in prostatic cancer cells. Grollman holds that acid phosphatase in prostatic cancer does not enter the circulation in detectable amounts until the neoplasm breaks through the capsule with local infiltration or distant metastasis. Then the serum acid phosphatase becomes elevated in as high as 85 per cent of patients (Sullivan, Gutman and Gutman). In a fair number of patients, however, with extensively disseminated lesions this enzyme remains normal in the blood (Alyea and Nesbit). Febrile reactions may temporarily reduce elevated serum acid phosphatase even in advanced cancer

Castration is usually followed by a sharp drop of the elevated serum acid phosphatase within a week This occurs more slowly (in 2 to 3 weeks) after estrogen administration. Failure of the elevated serum acid phosphatase to fall after castration or estrogen administration is usually accompanied by no clinical improvement Furthermore, it is a sign that the patient will not respond to antiandrogenic therapy and that the cancer cells have become autonomous and are no longer androgen dependent

Serum alkaline phosphatase is frequently elevated above normal (6 to 10 King Armstrong Units) in prostatic cancer. It reflects activity of bone around tumor metastasis Patients with bone metastasis have an increase in level of serum alkaline phosphatase in about one-third of the cases In a large number following castration there is a sharp rise followed by a gradual decline in the level of this enzyme to normal, reflecting a decreased metastatic activity with bone healing. The serum alkaline phosphatase is less likely to rise in patients treated with estrogens.

Elevated serum acid phosphatase has come to be regarded as evidence of bone metastasis and its rise or fall is interpreted by many authors as an index of response to endocrine treatment. Its rapid or progressive rise is an unfavorable sign Huggins felt that failure of the serum acid phosphatase level to fall after orchiectomy may be due to extratesticular androgen formation probably in the adrenal cortex and that this feature was an indication for estrogen

therapy In many of these cases it is also probable that the tumor cells have become androgen independent Contrary to these views Nesbit feels that the serum acid phosphatase is not a reliable index of metastatic activity

Sedimentation Rate of Erythrocytes

Numerous authors have called attention to the frequent finding of accelerated erythrocyte sedimentation rate in malignant disease, especially when metastatic Boylan and Tillisch and others have studied the matter in relation to prostatic cancer and feel that the sedimentation rate should be taken into consideration with acid phosphatase levels in evaluating the activity of this disease

The Significance of the 17 Ketosteroids

These substances are steroids having a ketone group of the 17th carbon atom They are produced in the testis and adrenal cortex and their quantitative estimation in the urine is regarded as an index of the androgenic activity of these organs They include androsterone and related compounds as well as estrone The estrone can be eliminated by treatment with alkali, leaving the urinary androgens, which can be further divided into alpha and beta fractions, the latter being precipitated by digitonin

Several authors have studied the excretion of 17-ketosteroids in prostatic disease but Frame and Jewett, and Satterthwaite, Chute, and others found that there were insignificant differences in the daily excretion of these steroids in the urine of prostatic cancer patients and in that of normal men in the same age group Huggins and Scott found in four cases of prostatic cancer treated by adrenalectomy after castration as a further antiandrogenic regimen that the 17 ketosteroids practically disappeared

The general opinion is held at present that 17 ketosteroid determination is not of great prognostic value in treating prostatic disease Castration decreases estrogen urinary excretion and some authors state that it causes a late rise in urinary androgens (17 ketosteroids) from adrenal activity Likewise the pituitary gonadotrophic hormone excretion in the urine rises following castration Estrogen (stilbestrol) administration decreases 17 ketosteroid output and that of the pituitary gonadotrophic hormone Estrogen administration causes a rise in urinary estrogen assays

Clinical Treatment of Prostatic Cancer

Antiandrogenic therapy of prostatic carcinoma centers chiefly around castration and the administration of estrogens Castration in a majority of cases is followed by relief of pain, increase in appetite in hemoglobin, and in general well being However, there is loss of libido and the power of erection The prostate becomes softer and diminishes in size Bony metastases frequently show increased calcification by x ray and at times apparent healing Frequently patients have hot flashes which can be controlled by estrogens Injection of testosterone probably reactivates the growth as pain becomes

intensified and the serum acid phosphatase level rises. In performing orchiectomy only the glandular tissue of the testis is removed but this must be done thoroughly.

Estrogen therapy if successful produces these results more slowly, but some outstanding urologists such as Kearns (who uses Estinyl 0.05 mg. daily) and Dean advocate estrogen treatment initially. Herger and Sauer and Nesbit ran parallel series of cases, one treated initially by castration and the other initially by stilbestrol. Herger and Sauer felt that estrogen is useful initially in selected cases but that these should have frequent examinations and that castration should be done when changes in prostatic size, infiltration of the pelvis, obstructive symptoms, or elevation of the serum acid phosphatase are noted. Nesbit's clinical results from castration and estrogen therapy were somewhat identical but there was more regression in the size of the gland in patients treated with castration. Pain in certain patients after castration was relieved by stilbestrol. Herbst, Emmett and Greene, and Alyea advocate, as a rule, initial castration followed by estrogen in varying dosage and type. Deming feels that castration and estrogen produce about the same result. In general it is agreed that castration should be the initial procedure when extensive malignancy and metastasis are present and when the patient does not show a favorable response to estrogen. However, when castration has not produced a favorable response, as a rule estrogen will not bring improvement. Alyea, in a series of 40 patients treated by orchiectomy and followed over a three-year period, found that 32 per cent were dead in two years. Of 23 with metastasis, 32 per cent were dead within one year and 42 per cent within two years.

Munger has been the champion of x-ray irradiation of the testis as a means of castration. This is combined with regional irradiation. Others have suggested irradiation of the adrenals and even of the pituitary, especially when reactivation of the cancer occurs following castration and estrogen therapy. However, such measures have not attained wide acceptance.

The life expectancy following antiandrogenic therapy has naturally not been consistent in the numerous reports such as those of Alyea, Budsall, Wear, Carroll, Seamans, and others. Bumpus in 1926 found that in 485 cases when no treatment was given the average duration of the disease from the first symptoms to death was 31 months. Surgery and irradiation prolonged life but little, while relief of obstruction (at that time by cystostomy) on an average prolonged life to 57 months. The variability of cancer in its grade and progress in the individual patient, the extent of the lesion at the time treatment is undertaken, and other factors make it difficult to answer the question as to how much longer patients will live after antiandrogenic treatment than if they had not been given this therapy.

Antiandrogen Treatment Preliminary to Total Prostatectomy

Recently certain urologists, among others Colston and Gutierrez, have proposed castration and estrogen treatment in selected cases of prostatic cancer which have progressed just beyond the stage where radical total prostatectomy is indicated When the gland responds by shrinkage and peripros-

tatic induration subsides, total prostatectomy may be performed with operative recovery as a rule. This use of antiandrogen therapy is hopeful but we must await the passage of time to evaluate its efficacy.

In summary we may say that castration and estrogen therapy give relief and restore well-being to the patient with prostatic cancer. They produce regression of the growth for a variable period of time. How long they actually prolong the life expectancy of the patient, in spite of an abundance of clinical evidence, remains a disputed point.

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CHAPTER XLIII

THE PROSTATE GLAND

General Considerations, Pathology, Transurethral Resection, Prostatectomy, Operations for Cancer of the Prostate

Obstructive lesions of the prostate gland present many interesting pathological variations. It is therefore obvious that no single method of treatment can be expected to correct widely varying types of lesions and in all cases alike restore the urinary tract to normal function. The crippling effects of the obstruction on the upper urinary tract and on the circulatory system, together with the many complications that may attend advancing years, likewise require variations in the treatment administered.

Although it is my purpose here to discuss the surgical management of prostatic obstruction, the subject will be clarified if we preface the discussion by a brief outline of the pathological and clinical problems encountered. In the previous chapter Dr Linwood Keyser has discussed endocrinology and endocrine therapy of the prostate. The three major pathological changes in the prostate are carcinoma, median bar and glandular hypertrophy.

Carcinoma of the prostate is similar to carcinoma arising in other glandular organs. They are usually recognized as scirrhus and adenocarcinomatous growths. Medullary carcinomas are rarely encountered. They occur in the same age group and are frequently associated with benign hypertrophy of the prostate. Carcinoma, however, is not related to benign hypertrophy which arises from the periurethral glands while carcinoma arises from the parenchyma of the true prostate usually near the periphery. Carcinoma has been thought to arise usually in the posterior lobe of the prostate but careful studies have demonstrated its origin in all parts of the gland. After infiltrating the prostate, carcinoma invades the seminal vesicles. It may metastasize to any organ but is most frequently recognized in the bones of the pelvis and spine. Because of the fact that obstructive symptoms occur rather late, the disease is not often discovered until it has spread beyond the prostatic capsule. The early lesions are usually situated near the surface, are flat and stony hard. When the entire prostate is invaded, it becomes fixed to the surrounding tissues. The etiology of carcinoma of the prostate is no better understood than that of cancer elsewhere. The rapidity of growth is usually influenced by endocrine therapy but in no instance so far reported has there been a cure either by castration or the administration of stilbestrol. Carcinomatous changes have been reported in from 14 to 29.4 per cent of men past fifty years of age. The incidence of malignancy is much higher in the very elderly patient.

Median bars result from fibrous tissue contraction following long continued inflammation of the prostate involving the bladder orifice. The tissues about the internal sphincter become somewhat fixed, with stenosis and a lack of elasticity

of the internal sphincter. The patient is usually younger and in better physical condition than the patient suffering from glandular hypertrophy, but the symptoms and pathological changes in the bladder and kidneys are similar In my experience, diverticula of the bladder have occurred more frequently with median bars than with glandular hypertrophy. This seems logical since the formation of the bar is a slower process than the growth of glandular hypertrophy.

Fibrosis and fixation of the vesical neck require an added effort of the muscle of the trigone which after a prolonged period causes hypertrophy of this structure. Occasionally the trigone becomes so thickened that it causes additional obstruction (Fig. 621) and an operation is necessary to divide the trigone before normal bladder function is restored (Fig. 622).

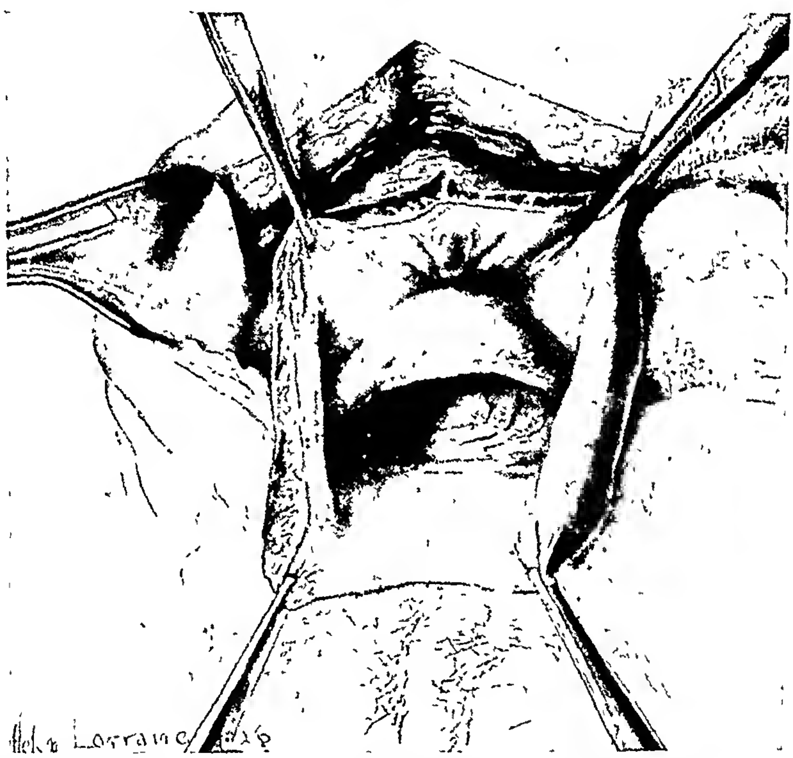

Fig 621.—Hypertrophy of the trigone caused by fibrosis (median bar) of the bladder orifice The hypertrophied trigone causes additional obstruction (Dodson. Southern Medicine and Surgery, December, 1929.)

True glandular hypertrophy consists of a proliferation of glandular tissue in, or adjacent to, one or more of the lobes of the prostate. The most frequent hypertrophies arise from the lateral lobes and the posterior commissure or median lobe. When hypertrophy is confined to the lateral lobes the enlargement remains below the internal sphincter. The urethra is encroached upon laterally and its anteroposterior dimension is greatly increased. The internal sphincter is not dilated This is the class of patients who may present very large glands on rectal palpation with very little residual urine. They are subject to attacks of complete retention which may subside after catheterization or a few days of bladder drainage, leaving the bladder function clinically almost

normal until a similar attack returns These patients often encouraged by such experiences delay operation until their general health is greatly impaired Such cases may also give a false sense of value to nonsurgical measures, such as hormonal therapy, in the treatment of prostatic hypertrophy

Posterior commissural hypertrophy presents itself as a mass of glandular tissue bulging from the posterior area of the internal sphincter The sphincter is dilated and often assumes a crescentic appearance The trigone is hypertrophied as a result of interference by this glandular mass with its normal function When lateral lobe enlargement accompanies hypertrophy of the posterior commissure the hypertrophied tissues protrude through the dilated sphincter, often producing very large masses in the bladder When the bladder musculature can no longer overcome the obstruction, residual urine slowly

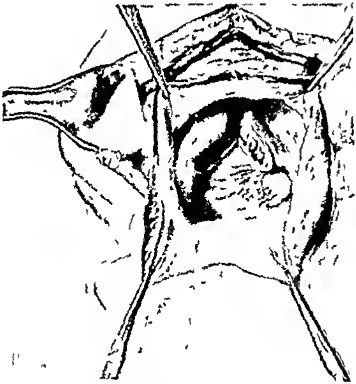

Fig 6.2 —Trigone divided in midline permitting free bladder drainage (Dodson Southern Medicine and Surgery December 19 9)

but constantly increases the bladder wall becomes thinned out and frequently pronounced impairment of the kidneys occurs before the patient realizes his need for medical attention Once complete retention has occurred, normal voiding is not re established except by the removal of the obstructing tissue The subcervical glands of Albarran situated beneath the trigonal mucosa at the sphincter, may hypertrophy producing another type of middle lobe The mass of tissue is somewhat more rounded than posterior commissural hypertrophy, and is often almost pedunculated Growing above the muscle it does not cause hypertrophy of the trigone It does however, produce a most effective barrier to normal voiding The growth causes dilation of the sphincter

and when accompanied by lateral lobe hypertrophy, it produces a pathological and clinical picture similar to the combined enlargement of the lateral lobes and of the glands of the posterior commissure. Significant enlargement of the anterior commissural glands is unusual and never in my experience has occurred except in unison with hypertrophy of other areas. Since the advent of transurethral resection, failure to restore bladder function has resulted from overlooked masses of tissue in this area. The posterior lobe of the prostate is often the site of carcinoma, but is rarely involved in benign hypertrophy.

In addition to pathological variations, the clinical course of the prostatic patient is influenced by a number of factors, including infection, calculi and circulatory disturbances, as well as unrelated constitutional diseases. These factors influence both the course of the disease and the method of treatment. The choice of treatment therefore must be determined after careful study, not only of the nature of the pathology and of the clinical manifestations, but of unrelated diseases and frequently of the social and economic problems as well.

It is the experience of most urologists that the average patient seeking relief for prostatic obstruction is in better physical condition than in former years. Kretschmer and Squire found that a group of patients studied from 1945 to 1947 sought relief on an average of 17.5 months earlier after the onset of symptoms than did a group treated from 1933 to 1937 and as a consequence had fewer complications and less damage to the kidneys. Edwin Davis has also called attention to the high percentage of good risks seen by the urological surgeon and has emphasized the fact that such patients may be operated upon without preliminary drainage or prolonged preoperative treatment. This is a safe procedure when the patient's kidneys and circulatory system have not been impaired by prostatic back pressure, but if there is pronounced infection or evidence of renal impairment it is well to be more cautious.

In the advanced stages of obstruction there is always some impairment of the kidneys and often of the circulatory system. Re-establishment of drainage preliminary to operation improves the function of these organs and permits prostatectomy to be done with relative safety. The type of drainage to be instituted must be decided for each case. An indwelling catheter is the method of choice if the patient can tolerate it. Many patients suffer so much from the presence of the catheter that it is necessary to institute drainage by suprapubic cystostomy. When this is done a soft mushroom or Foley catheter is introduced and the bladder sutured watertight around it, thereby making the patient much more comfortable.

I frequently use the trocar to establish suprapubic drainage in greatly debilitated patients when the bladder can be palpated above the pubis. There is little danger of peritoneal injury and it causes much less shock than cystostomy. When drainage must be continued over a period of weeks, it is safer than catheter drainage because of the relative freedom from infection.

The length of time required to determine when patients can stand prostatectomy differs in every case Those coming early with very little residual urine and all of their organs functioning normally may be operated upon after

a few days of preliminary care, while others may require weeks or months. Improvements in chemotherapy and the addition of antibiotic therapy have greatly diminished the incidence and dangers of infection and as a consequence have permitted the period of preliminary treatment to be greatly reduced in most cases. The indiscriminate prescribing of penicillin and streptomycin in every patient as a prophylactic measure or in mild infections is not wise. A fair number of patients become sensitive to penicillin, and some bacteria are known to develop resistance to streptomycin. Except in acute fulminating infections, it is well to depend upon cultures and sensitivity tests to determine the drug of choice. The prophylactic administration of small doses of a sulfonamide is definitely helpful during the period of drainage either with tube or with catheter.

It is interesting to note that constant drainage of a bladder long accustomed to retention seems to have as much beneficial influence on the crippled heart and vascular circulation in some cases as it does on the damaged kidneys. There is usually a fall in blood pressure following the relief of long continued retention of urine. In a series of 56 patients O'Conor found that the average fall of systolic blood pressure during the first 24 hours was 40 mm. of mercury and that the average fall of the diastolic pressure was 14 mm. of mercury. This fall in blood pressure is a considerable factor in the temporary decline in renal function that is often noted following the institution of bladder drainage. In recent years the necessity of gradual decompression of the chronically distended bladder is questioned by many experienced urologists. The danger of immediate and complete drainage has certainly been overemphasized in the past but gradual bladder decompression should not be abandoned entirely. It is an added safeguard to the elderly patient with hypertension, diminished renal function and a large retention of urine that has existed many months.

It will usually be noticed that following the institution of drainage the patient's kidney function, blood pressure, and sense of well being decline together for the first few days, and during this time the patient should be closely watched. A full intake of fluids is required and active supportive measures are instituted if necessary. Diuretics have not proved of value in our hands, and hot packs are too depressing for the average old man. Uremic symptoms can usually be controlled by a large intake of fluids, free elimination of the bowels, and cardiac support.

Following the institution of drainage, the blood pressure is taken daily and the kidney function checked up once or twice a week, according to the patient's general condition. The phenolsulfonphthalein test, the blood urea nitrogen estimation and the specific gravity and total volume of the urine are the guides to the kidney function. These tests often show fluctuation during the first few days following drainage. When the kidneys become adjusted to normal conditions and begin to improve in function, the tests taken at different times become more constant, indicating that the kidneys have reached their normal function. The blood pressure also fluctuates markedly following the institution of drainage, and a constant blood pressure should be maintained at

least three days before prostatectomy is done. Every patient with any cardiac weakness should be thoroughly studied by an internist and appropriate treatment instituted.

The choice of an anesthetic enjoys a prominent place in the literature on this subject. In most cases spinal anesthesia is quite satisfactory and for prostatectomy not more than 100 mg of Novocain is needed. If the patient is given ¾ of a grain of ephedrine immediately before the anesthetic, very little fall in blood pressure will result from so small a dose Safety is increased by giving 5 per cent dextrose in Ringer's solution intravenously during the operation. The rate of flow is regulated by the blood pressure. When spinal anesthesia is contraindicated, ethylene-oxygen is an ideal anesthetic for these patients It gives sufficient relaxation for operation by either route, does not seem to retard the function of any organ, and is peculiarly free from the nausea and flatulence so distressing to these old men after other general anesthetics.

Just before the patient is taken to the operating room his urethra and bladder are thoroughly irrigated with boric acid solution. As soon as the patient is under the anesthetic, a 5 per cent solution of dextrose in Ringer's solution or water is given slowly by vein In this way a large amount of fluid is given without discomfort to the patient and when most needed

Choice of Treatment

If carcinoma is recognized or strongly suspected while still confined to the prostate, Young's radical perineal operation, or radical retropubic prostatectomy, consisting of removal of the entire prostate along with the seminal vesicles and a cuff of the bladder, offers the only chance of cure When the diagnosis is uncertain, a biopsy should be obtained upon exposure of the prostate, and a less radical operation is done if cancer is not present

Unfortunately, only a few urologists have interested themselves in the early diagnosis and radical treatment of prostatic carcinoma This results partly from the fact that most prostatic cancers are inoperable except as a palliative procedure before the patient seeks relief for obstructive symptoms The factor most responsible is the lack of familiarity by most urologists with perineal exposure of the prostate gland. The recently developed retropubic approach to the prostate is adequate for total prostatectomy. When we consider the large percentage of men past 50 years old who have prostatic carcinoma and the gradually increasing longevity of life, all urological surgeons should equip themselves to join the few who over the years have kept this problem constantly before us While the number of reported cures is not large, the percentage of cures in operable cases compares favorably with that of other cancerous lesions. Cure has not been effected by any other method of treatment.

In the more advanced cases the purpose of treatment is to afford bladder drainage, to retard growth and metastasis of the cancer and to keep the patient as comfortable as possible. Even though cancer of the prostate usually terminates fatally, the administration of stilbestrol, castration, or the proper use of radium, x-ray or a combination of these agents will frequently cause a temporary retrogression of the process and retard metastasis Radiation is also helpful

in relieving the pain produced by metastatic growth. When obstruction has advanced to the point of difficult voiding and is not relieved by the treatment just mentioned I prefer transurethral resection for removal of the obstructing tissue. When obstruction is complete the resection must precede stilbestrol or castration. Permanent suprapubic drainage should be used only in those cases too feeble to permit more radical treatment or when all other methods of restoring bladder function have failed.

In obstruction by median bars bladder function is restored by the excision of small amounts of fibrous tissue from the posterior portion of the internal sphincter area. This condition is suspected when the patient is presenting the symptoms of prostatic hypertrophy and has no palpable enlargement of the gland. The patient is usually younger by ten or fifteen years than the average patient with benign hypertrophy, although occasionally bars are seen in the very aged. The condition is determined by cystoscopic study. Young was the first to recognize that prostatectomy was unnecessarily extensive in these cases and devised his "punch" which is quite satisfactory in removing sufficient tissue to restore bladder function. At the present time Young's instrument is not so widely used as a number of modifications which are equipped with more adequate visual systems. I have used the McCarthy resectoscope and the Day punch with equal satisfaction in treating these cases. When the bar is complicated by nodules of prostatic tissue, the resectoscope is more satisfactory. Keyes devised a rongeur for excising these bars suprapubically which is useful when the bar is complicated by a stone or a diverticulum which necessitates the opening of the bladder. In such cases the bar may also be excised by a high frequency loop electrode.

It has been the experience of most urologists that resections in these apparently simple obstructions are not as satisfactory as in those patients with prostatic hypertrophy.

Recontraction with return of symptoms is a common occurrence. In some patients urinary frequency and suprapubic discomfort persist even though obstruction is relieved. Recently some of these patients have been operated upon retropubically with considerable success. After exposing the anterior surface of the lower part of the bladder and prostate a longitudinal incision about three inches long is made from the bladder into the prostatic urethra exposing the bladder orifice. About two thirds of the incision is in the bladder. Obstructive tissue at the bladder orifice can be removed by rongeur or scissors and the bleeding controlled by a running suture or fulguration. The wound is then sutured transversely bringing the healthy bladder wall into the prostatic urethra thereby preventing recontraction. If one prefers a Y type incision can be made thereby leaving a V shaped flap to be drawn into the urethral incision when closing. We have been pleased with the results in a few patients operated upon by this method.

In the treatment of benign hypertrophy of the prostate it is the purpose of the surgeon to restore the bladder to normal function. When this is accomplished urinary drainage is assured and the kidneys and circulatory system

are relieved of the devastating influence of back pressure. Nonsurgical measures are useful in the very early stage of hypertrophy, in the preparation of patients for prostatectomy and when the operation must be deferred because of physical or economic reasons. Patients who are seen in the early stages of hypertrophy do not always require surgical treatment; in fact, the advisability of operating upon all early cases is questionable. When the kidney function is good, the residual urine not more than an ounce and free of infection, the patient may be permitted to delay treatment, with the advice that he report at intervals of six months for examination. Urinary frequency in the early stages results from congestion or infection and is usually relieved by prostatic massage, gentle gravity irrigations and urinary antiseptics Favorable reports from the use of testicular hormones in early cases have been recently published. Similar treatment is helpful in more advanced cases when because of feeble health, or business or financial reasons, operation must be deferred. In no instance, however, should the surgeon suggest the probability of complete and permanent relief by any other means than enucleation or excision of the hypertrophied prostatic tissue Hypertrophy of the prostate is a slow but continuous process and although it may be delayed by palliative measures, the enlargement, if not removed, continues until complete obstruction has occurred.

The location and size of the hypertrophy, the degree of kidney damage and the age and physical condition of the patient should be carefully considered when choosing an operative procedure for the relief of prostatic hypertrophy. Transurethral resection or excision of hypertrophied tissue has now been used sufficiently long for its usefulness to be accurately evaluated. While a few expert and enthusiastic urological surgeons prefer to treat all cases in this manner except those in which, for some reason, the instrument cannot be passed into the bladder, the majority take a more conservative view and apply it chiefly to those enlargements at the vesicle orifice and to moderate hypertrophy of the lateral lobes When there is advanced hypertrophy of the lateral lobes alone or combined with hypertrophy of the posterior commissure or Albarran's gland, most operators prefer to enucleate the gland. The surgeon whose experience with the resectoscope is limited will do well to limit his resections to the smaller hypertrophies Patients with badly infected glands who respond to instrumentation with chills and fever will do better with suprapubic drainage and enucleation of the gland. This is likewise true of the occasional patient whose gland is very vascular and bleeds freely upon the most gentle instrumentation. In aged and feeble patients suprapubic prostatectomy is attended by a higher mortality than either transurethral resection or perineal prostatectomy. The experience of the operator should influence the procedure.

The choice between perineal and suprapubic prostatectomy has been a controversial subject since the beginning of prostatic surgery. The relative simplicity of suprapubic prostatectomy has made it the choice of a majority of surgeons and especially those who do prostatectomy only occasionally. Perineal prostatectomy, although more difficult of execution, ensures a higher percentage of recovery and in the hands of the experienced operator gives equally good

functional results, furthermore, the surgeon who is familiar with the perineal approach is better equipped to deal with the various pathological processes that may occur in the posterior urethra, prostate, and seminal vesicles

There has been considerable change in the management of patients subjected to suprapubic prostatectomy during the past few years There is greater preference for a one stage operation and a tendency to shorten the period of preoperative preparation in all except extremely debilitated and uremic patients The safety of this program is greatly enhanced by more adequate control of infection and the application of absorbable hemostatic agents Most surgeons of experience develop a technique suitable to themselves but there are increasing reports of primary closure of the bladder or of the use of a small suprapubic tube for 24 to 48 hours Many of these patients are discharged well in from ten days to two weeks The majority of patients requiring preoperative drainage are drained safely and comfortably with a small Foley catheter, and, with adequate chemotherapy, preparation is rarely prolonged by infection of the kidneys or epididymides Two stage suprapubic prostatectomy remains a useful procedure in debilitated and uremic patients especially when the disease is complicated by bladder pathology A suprapubic cystostomy is done, at which time the bladder may be explored and stones if present removed If there is a diverticulum it should be removed at this time if the patient's condition justifies the added risk After a period of drainage sufficient to restore the patient's kidney function to a safe level and when his general physical condition will justify it, the bladder is reopened and the prostate is removed In extremely debilitated or uremic patients a period of drainage by a catheter in the urethra or by a tube placed suprapubically through a trocar adds to the safety of the first stage Suprapubic cystostomy alone, done routinely and immediately upon admission, is responsible for a considerable mortality When the patient enters the hospital in good physical condition with little or no impairment of the kidney function, suprapubic prostatectomy may be done safely at one operation with considerable saving in time and discomfort to the patient

The retropubic approach for operations upon the prostate has recently gained considerable favor This approach for enucleation of hypertrophied prostatic tissue was first utilized by W J VanStokum of Holland in 1909 Since then similar procedures have been reported by Otto Maier, Casper and Jacobs and by Hybbinett The operation did not come into popular favor until Terrence Millin developed and reported his technique of retropubic prostatectomy in 1945 Two years later he reported 1503 operations done by fifteen European surgeons with a mortality of 5 3 per cent The features as described by Millin are (1) It is an extravesical approach thus avoiding suprapubic drainage with the risk of slow closing or persistent fistula (2) It is relatively short and shock free operation (3) It is applicable to all types of prostatic obstruction (4) It does not interfere with or endanger any important organs (5) The whole of the obstructing prostatic tissue is removed (6) The convalescence is easy with relatively short stay in the hospital (7) The mortality rate is low

All reports are favorable as to adequate exposure adequate control of bleeding, and rapid and satisfactory convalescence Osteitis pubis has been

reported more frequently following retropubic prostatectomy than following other surgical procedures on the bladder or prostate, and a few instances of urethral stricture have been mentioned. In my own very limited experience, the operation has very definite merit.

TRANSURETHRAL RESECTION

Transurethral resection consists of the removal of the obstructing tissue in small portions by an instrument introduced through the urethra. Several instruments have been devised for this work. The most popular one is the Stern-McCarthy prostatic electrotome with the McCarthy visual system.

Some operators prefer an instrument patterned after the Young punch, but equipped with a more efficient visual system and with means for continuous irrigation and electrocoagulation for the control of bleeding. The Day punch and the Braasch punch as modified by Bumpus and by Thompson are popular instruments of this type. The Stern-McCarthy instrument is used in conjunction with a high-frequency current of sufficient intensity to cut under water.

The operation is highly technical. Its use should be limited to those thoroughly familiar with cystourethroscopic instruments and procedures. Though the operation may be done in all forms of prostatic obstruction, except the rare enormous enlargements, it is most useful in the correction of median bars, small and moderate middle lobes and mild general prostatic hypertrophy. Resection is contraindicated in very large prostates, in those which bleed freely upon the slightest instrumentation, in those in which there is marked distortion of the course of the urethra and in those in which the indwelling catheter incites persistent fever.

The preoperative preparation of a patient for transurethral resection does not differ from that in which an enucleation of the prostate is to be done. In robust patients with little residual urine and good kidney function, very little preparation is necessary. Those whose kidneys and circulation have been impaired by prolonged retention of urine require preliminary drainage and supportive treatment until the operation can be done reasonably safely. In all cases, preliminary x-ray examination of the urinary tract and cystogram or cystourethroscopic examination are desirable. By so doing, the type of obstruction is determined and such complications as stones and diverticula are located or excluded. A preliminary cystoscopic examination likewise tests the temper of the patient's urethra to instrumentation. The patient who has chills or runs a temperature followed repeated instrumentation is not a good risk for transurethral resection. Preliminary drainage in these cases is usually accomplished by an indwelling catheter. The bladder should be irrigated from one to several times a day depending upon the character of the urine, and the catheter should be changed and the urethra thoroughly irrigated at least twice a week. The patient should be free of fever at least two days before the transurethral resection is done.

It is desirable to keep the urine acid during the period of drainage. An acid ash diet and acidifying drugs may be used when well tolerated. Drugs to acidify the urine in patients with poor kidney function should be used with caution because of the danger of inducing acidosis. Urinary antiseptics and antibodies are helpful as a prophylaxis against infection. Sulfonamides or antibiotics administered for a few days before operation seem to reduce the probability of infection.

The operation is usually done with spinal or sacral anesthesia. When spinal is used, from 50 to 100 mg. of Novocain will give adequate anesthesia.

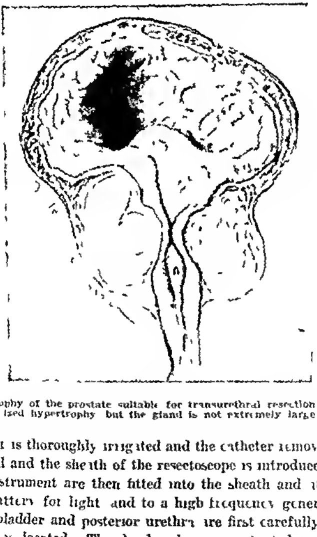

Fig. 622.—Hypertrophy of the prostate suitable for transurethral resection. There is generalized hypertrophy but the gland is not extremely large.

The bladder is thoroughly irrigated and the catheter removed. The urethra is then irrigated and the sheath of the resectoscope is introduced. The working parts of the instrument are then fitted into the sheath and attached to an irrigator, to a battery for light, and to a high frequency generator for cutting current. The bladder and posterior urethra are first carefully inspected. The verumontanum is located. This landmark is important, because to cut distal to it endangers the patient's urinary control (Fig. 623). Excision is usually begun upon the most obstructive portion of the gland, such as a median bar, median lobe or posterior commissure hypertrophy. The resection is continued posteriorly until all of the obstructing tissue is removed and there is a clear view from the verumontanum to the bladder (Fig. 624).

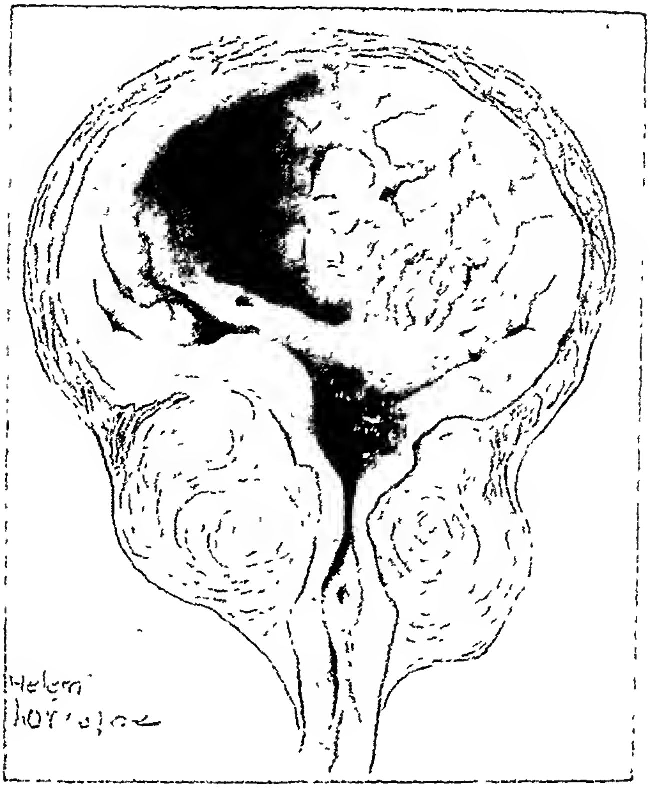

Fig. 624—The median lobe has been removed.

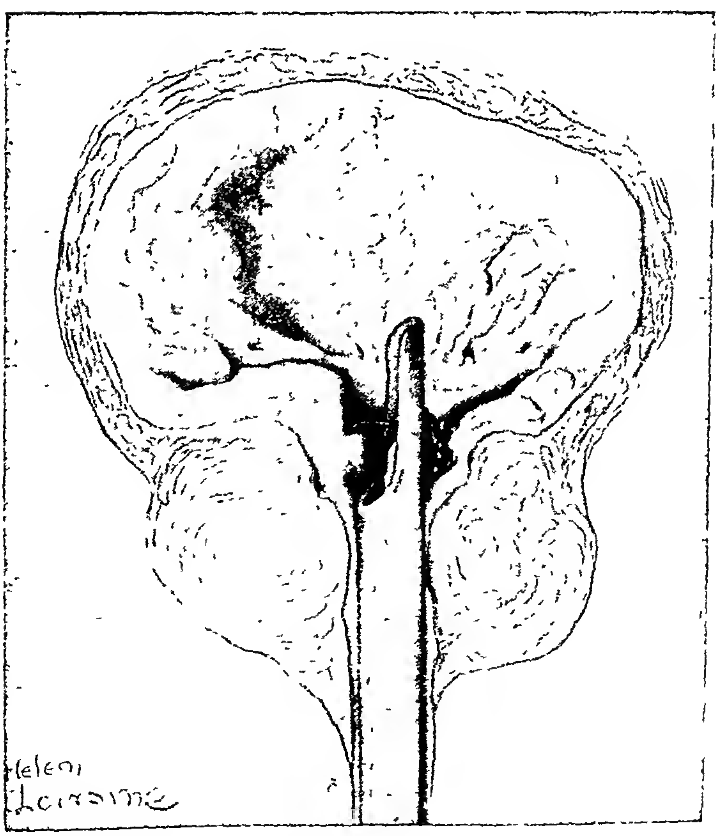

Fig 625.—The loop of the resectoscope engages the right lateral lobe.

If the lateral lobes of the gland bulge into the urethra, they should be removed first one and then the other (Fig. 625). It is much more satisfactory to complete the resection as far as possible in one area before going to another, as this makes it easier to control the bleeding and to keep one's anatomical bearings (Fig. 626). Before cutting in a new area, all bleeding points should be carefully controlled by fulguration.

The most satisfactory results are obtained when the hypertrophied prostatic tissue is completely removed. R. M. Nesbit states that the ideally performed transurethral prostatectomy should leave the entire inner aspect of the prostatic capsule exposed to the operator. In attaining this he advises that the resection begins in the anterior quadrant of the field where the capsule is more readily and safely approached. When the resection has been carried down to the capsule

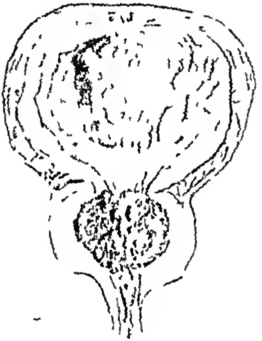

Fig. 626.—The completed operation. All obstructing tissue has been removed.

anteriorly it is continued down between the right lateral lobe and the surgical capsule. The circular fibers of the capsule are exposed almost but not quite to the verumontanum. The same dissection is then carried out on the opposite side, leaving the lateral and median lobes attached posteriorly by a slender pedicle. After controlling bleeding the partially detached median and lateral lobes are excised. The left index finger is then inserted into the rectum to determine the completeness of the resection and to push remnants of prostatic tissue into the field so that it can be excised.

By this method larger glands can be resected in the shortest possible time. Beginning the operation anteriorly and continuing around the periphery of the

gland next to the capsule divides the blood vessels to the great mass of the gland and when the bleeding from the lateral excisions has been controlled the remainder of the resection proceeds with very little bleeding (Fig. 627).

Such complete excision of the prostate by transurethral resection requires an accurate knowledge of the pathological variations encountered in prostatic

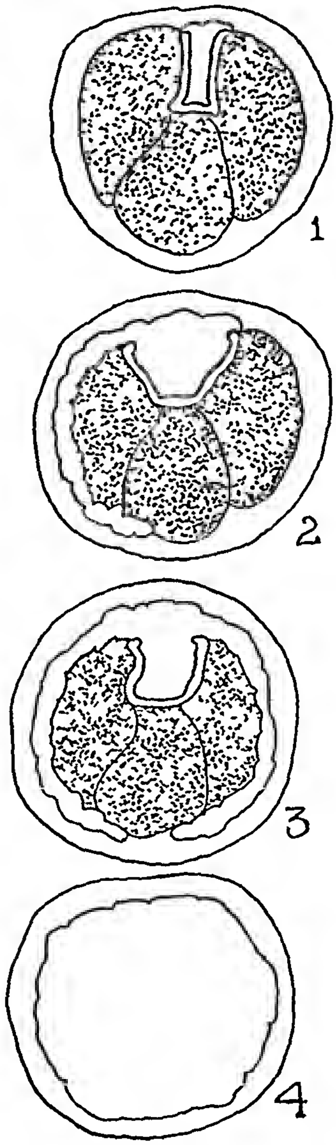

Fig 627—Technique of transurethral resection advocated by Nesbit (cited by Greevy). (1) Resection begun at 12 o'clock and deepened until the circular fibers of the capsule are seen Lateral lobes are thereby detached from one another and fall back laterally and medially (2) Resection carried down between right lateral lobe and surgical capsule, circular fibers are exposed almost to the verumontanum (3) Same procedure carried out on left side until lateral and median lobes are held by a slender pedicle Bleeding is controlled, and pedunculated lateral and median lobes are excised (4) The completed operation

hypertrophy and through familiarity with the limitations of the operative field When all obstructing prostatic tissue is removed, and no tags or nodules of tissue can be seen bulging into the bladder or urethra and when the bleeding has been stopped, the resectoscope is removed and a large catheter No. 22 or No. 24 French, preferably with two eyes, is inserted and tied in the urethra.

If bleeding is difficult to control, a Foley bag or similar instrument may be inserted The bag is inflated and traction is made on the catheter, thus adequately controlling the bleeding by pressure I prefer to use these bags only in those cases in which the control of bleeding by fulguration would prolong the operation beyond the point of safety Infection is encouraged by their presence The patient is returned to his room, given fluids freely by mouth, if possible, by hypodermoclysis or intravenously if necessary, and the catheter is watched carefully for bleeding and irrigated sufficiently often to prevent occlusion with clots The urine is usually blood tinged for twelve to twenty four hours, but if hemostasis is carefully carried out at operation, no trouble is experienced

V J O'Conor has used thrombin (topical) to advantage in controlling troublesome oozing after all spurting points had been controlled Ten thousand units of thrombin dissolved in 10 c c of normal saline is injected slowly through a Foley catheter and the catheter lumen is closed After several minutes the bag is inflated and gently drawn down into the prostatic cavity The catheter is kept closed from thirty minutes to an hour before it is attached to drainage The bladder is not irrigated unless there is evidence of continued bleeding If bleeding is sufficiently profuse to form clots in the bladder, the patient should be returned to the operating room, the clots removed and the bleeding points fulgurated Occasionally a patient bleeds so profusely during the operation or afterward that control through the rectoscope is impossible In such cases one should not hesitate to open the bladder suprapubically and pack the prostatic cavity

Catheter drainage is usually necessary for about a week following the operation We prefer to leave the catheter in until the fever has subsided Occasionally a degree or two of fever persists until the catheter is removed Following removal of the catheter, the patient should be catheterized and the bladder irrigated every twelve hours until the patient is able to empty the bladder completely The retention of infected urine following a resection is quite dangerous often causing chills and fever

The principal complications that may occur during this operation are hemorrhage, rupture of the bladder, and injury to the bladder Excessive hemorrhage is rare if one is careful to control the bleeding following each cut that is made, and to stop all bleeding in one area before turning to another Rupture of the bladder is rare and results from overdistention If rupture occurs, the patient complains of severe abdominal pain and muscle rigidity Immediate suprapubic exposure and repair of the injury should be done and suprapubic drainage established Injury of the bladder with the resectoscope usually results from cutting too far into the bladder, or cutting through and undermining the trigone This accident is recognized by difficulty in reintroducing the instrument into the bladder when it has been withdrawn into the urethra, by failure of the irrigating fluid to return satisfactorily, and by suprapubic pain and shock It is preferable in such a case also to institute immediate suprapubic drainage

The chief postoperative complications are hemorrhage and sepsis.* Hemorrhage may occur immediately because of inefficient control at operation, or a week to ten days following operation, resulting from slough. The prevention of primary bleeding has been discussed. Secondary hemorrhage is less apt to occur when fulguration has not been excessive and when the urethra and bladder have been kept clean by frequent irrigations. The aspiration of clots, thorough irrigation with warm antiseptic solution, and putting the bladder at rest by an indwelling catheter will frequently control secondary bleeding; if not, the resectoscope should be introduced and the bleeding points fulgurated.

We have previously mentioned the importance of delaying operation until the temperature remains normal for at least two days and the value of acidifying the urine and administering urinary antiseptics before operation. Patients who persistently have fever following instrumentation or the application of an indwelling catheter are poor subjects for resection. Extensive fulguration of the resected area and cutting into the bladder wall are other causes of postoperative sepsis. Following operation, continued administration of urinary acidifiers and antiseptics or antibiotics and careful bladder and urethral toilet will prevent infection or keep it under control in most cases. Severe infection is treated by the continued application of the same measures with suprapubic cystostomy in gangrenous cystitis and acute pericystitis, and irrigation of the kidneys or drainage with urethral catheters when there is evidence of pyelitis with retention of urine.

Following resection, in some cases there may remain residual urine for as long as two weeks after the removal of the catheter. This is due to edema about the resected area. Such residual urine encourages infection unless it is drained off and the bladder thoroughly irrigated at least once a day. When the residual urine has disappeared, the irrigations should be kept up by the gravity method, using a urethral nozzle, until the patient's bladder function has returned to normal, usually in four to six weeks. When there is persistent frequency of urination or when there are shreds in the urine, the occasional passage of a sound and gentle prostatic massage are helpful. If residual urine persists, sufficient tissue has not been removed and the resection must be repeated. A second operation is always much less difficult than the first.

PROSTATECTOMY

Prostatectomy may be done by the perineal, the suprapubic, or the retropubic route There are ardent advocates of each route though the suprapubic operation is most popular. The operation of H. H. Young or one of its modifications is generally used for the removal of the prostate through the perineum The suprapubic method is simpler and the enucleation following the general principles of the technique of Squires has given excellent results

*Attention has been called to the danger of hemolysis from the use of distilled water as irrigating fluid during the resection (See references, Creevy and Nesbit)

The operator should have the technique of either route at his command In the small fibrous prostate, especially if there is a possibility of malignancy, the perineal route is preferable In the adenomatous prostate projecting largely into the bladder, removal by the suprapubic route seems better The objections to the perineal route are

1 It is more complicated and the operation takes somewhat longer to perform

2 There is a possibility of injury to the rectum and fistula formation

3 Lack of control of urination may occur unless care is taken not to open the membranous urethra too far forward

The objections to the suprapubic route are

1 The removal of the whole urethra contained in the prostate is sometimes followed by stricture

2 If the prostate is cancerous and very adherent it can be removed more satisfactorily by sharp dissection through the perineal route than through the suprapubic

3 Drainage is less adequate by the suprapubic route and troublesome infection is more frequent

The choice depends somewhat upon the experience of the surgeon The operation, particularly the suprapubic operation is technically not very difficult, though it is essential to have had training in assisting and observing these operations done by one who is skilled in this work before the surgeon attempts the operation

The retropubic operation requires more technical skill than the suprapubic and is less difficult than the perineal operation Obesity adds considerably to the difficulty of retropubic exposure The operation is particularly useful in cases of large adenomatous prostates that can be done in one stage In skilled hands, a total prostatectomy is possible by this approach and it has the advantage of a shorter period of hospitalization

It is most important to have the patient in the proper condition to stand the operation The high mortality for prostatectomy in the early history of this operation was due partly to a crude technique but more to the inability to determine the functional capacity of the kidneys When there is much residual urine the back pressure upon the kidneys gradually alters the conditions under which they function and they gradually meet these changed conditions A sudden and permanent removal of this back pressure may affect the kidneys profoundly For this reason patients with evidence of renal damage should either be catheterized or drained for some days or for some weeks before a prostatectomy is done The renal function should be accurately determined, partly by chemical analysis of the urine but chiefly by functional tests of the kidneys No matter how skillful the operative technique may be if these patients do not show satisfactory renal function disaster is likely to follow If in doubt it is wise to drain either by an indwelling catheter or by suprapubic drainage, until such a time as the blood urea and phenolsulfonphthalein tests show that the kidneys are working satisfactorily

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Fig 628.—Two stage suprapubic prostatectomy The wound has been reopened and the superior angle protected by gauze With the left index finger inserted into the rectum to push the prostate upward the right index finger is inserted into the posterior urethra and the enucleation is begun near the superior portion of the right urethral wall If the surgeon is left handed the enucleation is more easily begun on the left side of the urethra

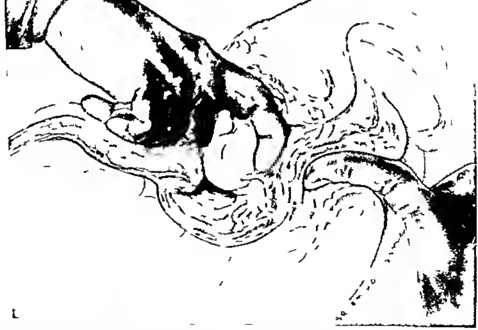

Fig 629.—The enucleation has extended backward separating the lateral lobes from the capsule The posterior urethra has been torn across and the enucleation continued backward on the opposite side From this point the prostatic lobes are carefully separated from the mucous membrane about the internal orifice of the bladder

SUPRAPUBIC PROSTATECTOMY

If suprapubic prostatectomy is to be done in one stage the bladder should be thoroughly irrigated, preferably before the patient leaves the ward, and the catheter left in position. The patient is placed upon the table in the supine position and an incision is made extending from just below the umbilicus to a point just above the pubis. A transverse incision about three inches above the pubis is also quite satisfactory. After incising the skin, subcutaneous fat and sheath of the recti muscles, the fibers of the recti and pyramidalis muscles are separated in the midline and the fascia immediately below them is incised, exposing the prevesical fat. At this time warm boric acid solution may be run into the bladder by gravity until the bladder rises into the lower portion of the wound The peritoneal fold in the upper portion of the wound is recognized and gently stripped upward with gauze. If the peritoneum is opened it should be carefully sutured. This area is then protected by a gauze sheet either clipped or sutured to the upper angle of the wound. The fat is then divided down to the anterior wall of the bladder and pushed to the side and downward into the space of Retzius. By dividing transversely the thin layer of fascia adherent to the anterior wall of the bladder (Fig. 340), dissecting the lower flap and suturing it to the muscle at the lower angle of the wound (Fig. 341), the space of Retzius is protected and troublesome infection in this area is less probable The bladder is emptied by permitting the fluid to flow out through the catheter and the catheter is removed. The bladder is opened transversely, avoiding as much as possible the large veins that course along its surface. After examining the bladder by inspection and palpation, the prostate may be removed by blunt dissection with the index finger, or by a combination of sharp and blunt dissection under direct vision. If the patient is quite fat with a thick abdominal wall, the advantages of vision will not compensate for the disadvantage of trauma caused by efforts to expose the gland. If the former method is selected, the surgeon, if right-handed, inserts his left index finger into the patient's rectum to push upward and fix the prostate The index finger of the right hand is inserted into the posterior urethra and a suitable area is sought to begin the enucleation It is usually more satisfactory to break through the mucous membrane just outside the bladder sphincter and near the upper margin of one of the lateral lobes (Fig. 628). If the prostate is not excessively fibrotic a line of cleavage is easily found at this area. As the lateral lobe begins to separate, the finger is carried posteriorly and downward, separating the hypertrophied tissue from the capsule on that side and posteriorly (Fig. 629). The urethra at the apex of the hypertrophied mass can then be torn across and the dissection continued along the other side, removing all the hypertrophied tissue in one mass. As the prostate is delivered into the bladder the base is carefully separated from the mucous membrane at the bladder orifice with as little trauma as possible (Fig. 630).

When the gland is stuck by adhesions at the apex, separation will be facilitated by grasping the base of the separated tissue with a tenaculum forceps and making strong traction upward Occasionally, because of the character of

ing is best applied by using a long roll of two inch gauze which is moulded carefully to the prostatic cavity. The end is left long enough to emerge from the upper angle of the wound.

The recently developed absorbable hemostatic agents are very useful in prostatic surgery. They may be used to exert pressure on the bleeding surfaces as with gauze or bags and they have the added advantages of inherent hemostatic ability and absorption or disintegration. Secondary hemorrhage is rare, whereas bleeding following the removal of plain gauze packs is occasionally quite disturbing. *Hemorrhage and infection have formerly been the two greatest hazards of prostatic surgery.*

Fibrin Foam, Gelfoam, and Oxycel gauze are the products now available. Fibrin Foam is a porous fibrin product supplied in thin strips which are soaked in a solution of thrombin and packed into the prostatic cavity. It may be used alone or with a hemostatic bag. Gelfoam, a synthetic product, has similar prop-

Fig. 731.—A Foley bag in place for control of bleeding. This bag which surrounds a large urethral catheter is inserted through the urethra, inflated and pulled down into the cavity. By making continuous tension on the catheter pressure controls the bleeding. This is very satisfactory when the cavity is not excessively large. When the cavity is very large or the bleeding is extensive it is best to control the bleeding by packing with gauze. After the bag or packing has been placed the suprapubic wound is closed with interrupted sutures of No. 1 chromic catgut in the bladder and silkworm gut in the abdominal wound. Space is left at the upper angle for a drainage tube and for the end of the gauze packing.

erties and is used in the same way. Large squares of Gelfoam may be draped over a hemostatic bag which is drawn into the prostatic cavity and inflated just enough to make gentle pressure on the bleeding surfaces. After about twenty-four hours the bag is deflated and the catheter retained in place for drainage.

Oxycel gauze is cellulose which has been oxidized with nitrogen dioxide. The gauze is acid and soluble in dilute alkali. It is supplied in strips and squares. It is more easily handled and in my experience more satisfactory for packing the prostatic cavity than either Fibrin Foam or Gelfoam. I usually use it draped over a bag 30 or 60 c.c. depending upon the size of the cavity. Usually

the enlargement or adhesions to the capsule, it is easier to separate and remove each lobe separately. If there is no hypertrophied tissue anteriorly, by dissecting forward and backward from both sides of the urethra a portion of the urethral mucous membrane anteriorly may be spared.

When exposure is difficult it is better to control bleeding from the prostatic cavity by pressure. Either gauze or an inflated bag may be used. If bleeding is profuse gauze is preferable, since it can be made to fit more accurately into the cavity and less intense pressure is required than with an inflated bag. When the bleeding is moderate a bag of the Foley type is quite satisfactory (Fig. 631). When the hypertrophied tissue has been removed it is well to pack the cavity snugly with hot moist gauze for about ten minutes. Much of the surface oozing is controlled and one can determine the amount of bleeding to be controlled. If a bag is to be used the catheter, equipped with

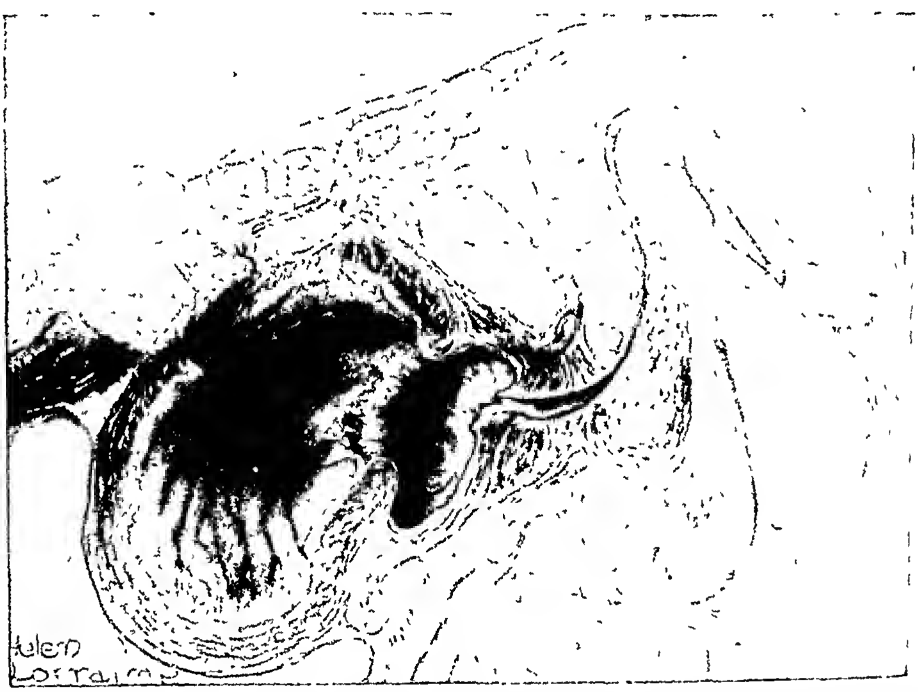

Fig 630—The prostatic cavity following the enucleation of the gland. The jagged edges of the mucous membrane about the internal orifice may be trimmed away with scissors or tucked into the prostatic cavity

a bag, is introduced through the urethra on a mandrin, the bag is inflated sufficiently to fit snugly into the bladder orifice and traction is made on the catheter until blood no longer trickles into the bladder. The catheter may then be strapped to the thigh, making constant elastic tension. If a Hagner bag is used, a sound is passed through the urethra and the tip is inserted snugly into the tube through which the bag is inflated. The sound and tube are withdrawn through the urethra, the bag is inflated and traction is made in the same manner. After three or four hours of pressure, the tension may be partly released, and should be completely released within twenty-four hours Prolonged pressure on the internal sphincter may cause incontinence of urine. Gauze pack-

ing is best applied by using a long roll of two inch gauze which is moulded carefully to the prostatic cavity. The end is left long enough to emerge from the upper angle of the wound.

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two layers of gauze are draped loosely over the bag and tied around the catheter at both ends of the bag The bag is drawn into the prostatic cavity and distended until the gauze is in contact with the bleeding surfaces. The bladder may be closed tight but I usually leave a small catheter suprapubically until drainage is assured through the urethral catheter. The bag is deflated in twenty-four hours and the catheter secured in place for drainage. If one prefers, the cavity may be packed with Oxycel gauze and the bladder drained suprapubically, or the gauze may be packed into the cavity surrounding a large straight catheter. The gauze distintegrates and passes out in the urine or irrigating fluid. Its disintegration may be hastened by mild alkaline irrigations

When the bleeding is satisfactorily controlled the bladder wound is closed by two rows of No. 1 chromic catgut sutures The first row includes the deeper portion of the bladder musculature and, beginning at the lower angle, is placed so that the mucous membrane of the bladder is turned inward The suture is tied at a sufficient distance from the upper angle of the bladder wound for the introduction of a drainage tube and, if gauze packing is used, to permit the end of the packing to emerge. A second row of sutures of similar material is placed as a continuous suture and includes the superficial portion of the bladder wall. When this suture is tied it is well to leave the ends long and pass them through the rectus muscle, one on either side of the incision. This fixes the cystostomy opening to the abdominal wall for a while and makes the reintroduction of a tube easier, should the tube be dislodged the first few days following operation. If a Foley bag or similar device is used for the control of bleeding, the bladder wound may be sutured snugly around a small tube at the upper angle of the wound; in fact, in a few cases we have closed the bladder completely, depending upon the Foley catheter for drainage. If gauze or a Hagner bag is used, sufficient space must be left to permit their removal. Therefore, it is best to place a rather large tube in the bladder alongside of which emerges the end of the gauze pack or a small cord leading from the base of the bag. The abdominal wound may be closed with interrupted sutures of No. 1 chromic catgut in the muscle and fascia, and interrupted sutures of coarse silk or dermal in the skin Space is left near the upper angle of the wound for the drainage tube and end of gauze pack when used It is well to place a small rubber drain down to the bladder in the lower angle and bring it out between the lower sutures. It is removed in about 48 hours Following operation the pressure from a bag should be completely released at the end of 24 hours but the inflated bag is left in the bladder a second day for pressure to be applied if bleeding occurs. After 48 hours the bag is removed, the urethra is flushed out with an antiseptic solution and a urethral catheter is strapped in for drainage, permitting the suprapubic fistula to heal Gauze packing should likewise be removed in 48 hours. It is more satisfactory to remove a portion of the gauze 24 hours after operation and the remainder a day later, when a catheter may be fastened in the urethra for drainage. Some surgeons prefer suprapubic drainage during convalescence, inserting decreasingly smaller tubes as the fistula contracts until finally gauze is depended upon to collect the drainage It has been my experience that the wound heals more rapidly with catheter drainage and it is used routinely except in patients who do not tolerate it. Often a suprapubic tube is likewise left in place

until the urine is free of blood. Regardless of the method of drainage, a dry bed contributes greatly to a smooth convalescence. The use of gauze packing should be rarely necessary at the present time.

If the patient is not obese or the bladder has not been previously opened, it is not difficult to expose the interior of the bladder, remove the prostate gland and control most of the bleeding by ligatures or by sutures. After retractors have been placed and the sphincter area is exposed, an incision is made through the mucous membrane and submucosa over the most prominent portion of the prostate as it bulges into the bladder (Fig. 632). After dissecting the posterior flap of mucosa from the prostate for a short distance, which may be easily done by inserting and spreading the blades of curved scissors, the prostate is grasped with forceps and pulled upward and backward as the dissection is continued with the finger (Fig. 633). When the gland has been entirely freed from the posterior capsule, it may be torn or cut from its attachment to the urethra and removed. If there is no enlargement of the anterior lobe, the mucous membrane of the posterior urethra may be incised longitudinally just above the lateral lobe on each side, leaving the anterior urethral wall intact. This is a desirable procedure, but rarely practical. When, as occasionally happens, the hypertrophy is confined to the posterior commissure or to Albarran's glands, the hypertrophied tissue may be enucleated, leaving the entire posterior urethra intact. When the hypertrophied tissue has been removed the cavity is packed for a few minutes with a sheet wrung out of hot salt solution which will stop much of the surface oozing. Any bleeding vessels visible should be clamped and ligated. The torn edges are trimmed away and the margin of the mucous membrane is sutured to the prostatic capsule in the posterior urethra (Fig. 634), care being taken not to suture too deeply for fear of including the rectal wall. One fairly deep interrupted suture on each side of the orifice, as suggested by Harris, is inserted and the mucous membrane is closed posteriorly by a continuous suture. Harris suggests sutures across the anterior half of the sphincter, taking bites deep in the fossa. These are difficult to place and are only useful when the sphincter has been widely dilated by the growth of a very large gland. If the bleeding has been controlled, a catheter may be placed in the urethra for drainage and the bladder closed as previously described, either entirely or with a small suprapubic tube for accessory drainage until the urine is clear. In most cases there is some oozing from the deeper portion of the fossa and it is better to insert a Foley bag, or tuck a piece of oxidized gauze into the prostatic cavity.

When prostatectomy is to be done in two stages the bladder is exposed as is described for the one-stage operation. If the bladder has been previously examined by cystoscope or by x-ray and cystogram there is no occasion for examining the interior of the bladder at this time. A No. 24 five c.c. Foley catheter is best for drainage. A purse-string suture is placed in the anterior wall of the bladder enclosing an area as far from the bladder orifice as practical. A stab wound is made through this area, the catheter is inserted, and the purse-string suture is tied (Fig. 341) and the balloon inflated. The long ends of the suture are brought through the recti muscles near the upper end of the incision and are tied lightly (Fig. 342). The abdominal wound is closed with the tube emerging near the upper angle.

Fig 632.—One-stage suprapubic prostatectomy. The bladder has been opened and the prostatic area exposed by the insertion of retractors The dotted line shows the incision which is made through the mucous membrane over the most prominent portion of the gland This incision should be carried down through the capsule

Fig. 633—The most prominent portion of the protruding prostate has been grasped with tenaculum forceps and pulled upward and slightly forward The enucleation here is begun by closed scissors or a knife handle until the finger can be inserted. From this point on the enucleation is done with the finger very much as in the second stage of a two-stage prostatectomy In rather stout patients, where exposure is difficult, it may be helpful to have an assistant insert the finger in the rectum and push the prostate u

If the bladder contains stones or diverticula it is necessary to open the bladder at this first stage. The operation of diverticulectomy is often rather extensive and if the patient is not in excellent condition preliminary drainage is desirable before the operation is attempted. Drainage should be done by an indwelling catheter or by a catheter introduced through a trocar and cannula. I do not advocate preliminary cystoscopy in every prostatic patient. With the knowledge to be gained by x-ray, including intravenous urography and cystogram, there seems little necessity for exploring the bladder at the preliminary operation. It adds to the danger of the operation, often causes infection of the wound, and increases the difficulty of keeping the patient dry during the preparatory period.

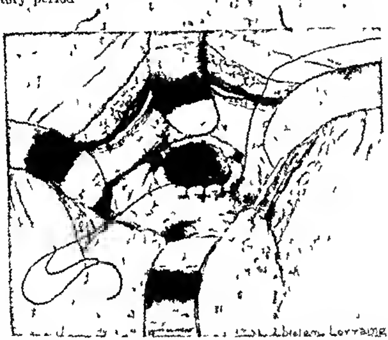

Fig. 634.—The prostate has been enucleated and the mucous membrane has been sutured to the prostatic capsule. This suture encourages healing and controls most of the bleeding. The two lateral sutures are taken rather deep. It has been shown by Harris that a large part of the postoperative hemorrhage occurs in these areas. When the sutures have been placed if there is still appreciable bleeding, it may be controlled by a Foley bag or a small gauze pack. The bladder may be drained with a catheter through the urethra or with a suprapubic tube or both. If the cavity is very dry, frequently it is possible to insert a large catheter and close the bladder completely.

The second operation is begun by making an elliptical incision, removing the old drainage tract down to the bladder. If the preliminary operation has been done only a week or ten days this is not necessary, for the previous wound may be opened. The bladder is incised from the cystostomy tube downward until sufficient room is obtained for enucleation and removal of the gland. The anterior wall of the bladder will be found fixed to the neighboring tissues by adhesions or by plastic exudate depending upon the length of time since the primary operation was done. In thin individuals it is unnecessary to disturb this attachment. The abdominal wall may be depressed and the finger introduced into the posterior urethra with very little trauma to the abdominal wound. In obese patients it is necessary to insert the entire hand in the wound, and

Fig. 632.—One-stage suprapubic prostatectomy. The bladder has been opened and the prostatic area exposed by the insertion of retractors. The dotted line shows the incision which is made through the mucous membrane over the most prominent portion of the gland. This incision should be carried down through the capsule.

Fig. 633.—The most prominent portion of the protruding prostate has been grasped with tenaculum forceps and pulled upward and slightly forward. The enucleation here is begun by closed scissors or a knife handle until the finger can be inserted. From this point on the enucleation is done with the finger very much as in the second stage of a two-stage prostatectomy. In rather stout patients, where exposure is difficult, it may be helpful to have an assistant insert the finger in the rectum and push the prostate upward.

chill followed by high temperature, a diminished urinary output, and sometimes with delirium or coma. The patient usually responds promptly to forced fluids and irrigations of the bladder.

For the prevention of pulmonary complications, the patient's position in bed should be changed frequently and he should sit up in bed as soon as possible. To insist that he get out of bed in three or four days, especially against his will, is not consistent with the best interests of the patient.

A stable kidney function and circulatory system before prostatectomy and the selection of the proper operative route to fit the prostate are extremely important. Direct transfusion of blood in the treatment of severe shock and hemorrhage, and forced fluids, free drainage and the continuation of cardiac stimulation, when necessary, are valuable measures in the therapy of these patients.

RETROPUBIC PROSTATECTOMY

Spinal anesthesia is preferable in the retropubic operation because of the relaxation of the abdominal muscles, permitting better exposure. After the patient's bladder has been irrigated and emptied and the lower abdomen prepared, the patient is placed in a moderate Trendelenburg's position. An incision is made beginning just below the umbilicus and extending downward over the symphysis pubis (Fig. 635) or a Pfannenstiel incision may be used. After dividing the skin and fascia, the rectus and pyramidalis muscles are separated and retracted laterally, exposing the anterior fold of the peritoneum and the perivesical fat. It is well at this time to ligate or suture all bleeding areas in the muscle or fascia. A self retaining retractor is then placed in position. With the finger, the loose perivesical fat is separated and drawn upward with the peritoneal fold and held in place with the posterior blade of the self retaining retractor or with a slightly angulated spatula. This exposes the anterior surface of the prostatic capsule. Loose fat adherent in this area is gently pushed forward. Several large veins are seen running along the anterior and lateral aspects of the prostate (Fig. 635). Gauze is packed gently on either side of the prostate to elevate and stabilize the gland. All visible prostatic veins are doubly ligated by underrunning them with needle and plain catgut. It is well to take a fairly deep bite in the prostatic capsule to prevent tearing the vein. These ligatures may be cut or left long and the ends held with hemostats for traction. I have found it useful to take a deep suture in the capsule on either side about where the ends of the transverse incision in the capsule are to be. These sutures with the ends left long for traction aid in elevating the prostate and in the control of capsular bleeding.

A transverse incision is made in the anterior surface of the prostate about 1 cm. distal to the bladder neck and between the ligatures that control the large superficial veins, down through prostatic capsule until the adenomatous tissue is recognized (Fig. 636). The incision extends almost across the anterior surface of the gland. Blood vessels encountered in the prostatic capsule should be clamped and transfixed with needle and catgut or fulgurated. Continuous suction aids in identifying the bleeders.

the unyielding anterior bladder wall will be torn from its attachments and at times into the peritoneum, causing dangerous contamination. It is therefore better in these cases carefully to separate the bladder from the overlying tissues and to protect the upper angle of the wound with gauze. The edges of the bladder wound may then be grasped with Allis forceps and the hand is gently inserted into the bladder before enucleation is begun. Enucleation is carried out as described above, using blunt finger dissection. Efforts to expose the interior of the bladder and prostate to direct vision through the fixed and unyielding abdominal wall that follows suprapubic drainage add unnecessarily to the time and trauma of the operation. When the hypertrophied tissue has been removed bleeding may be controlled by gauze or a bag as previously described. The wound cannot be closed as accurately as in a primary incision. It is quite satisfactory to use rather closely placed interrupted sutures of No. 2 chromic catgut in the bladder and subcutaneous abdominal tissues and interrupted coarse silk in the skin, leaving space at the upper angle of the wound for the drainage tube and the end of a gauze pack. One or two abdominal sutures are left untied until the packing is removed.

Postoperative Treatment

When the operation is over, the patient is returned to a warm room and kept absolutely quiet. Sufficient opiate is administered to relieve all discomfort. The pulse is closely watched, and frequent blood pressure readings are taken. In the event of excessive bleeding the packing is reinforced. Hypodermoclysis of normal saline or dextrose solution intravenously is given during the first twenty-four hours or until the patient has taken about 2,000 c.c. Intravenous administration of 5 per cent dextrose in Ringer's solution is excellent if the heart is in good condition. Fully 95 per cent of all prostatic fatalities are due to shock, hemorrhage, uremia and sepsis A persistently low blood pressure from shock or anemia from hemorrhage, in addition to its immediate danger, predisposes the patient to uremia and sepsis. Hemorrhage is a predisposing factor in shock, and direct blood transfusion is of inestimable value in the treatment of both hemorrhage and shock. In several cases we believe it saved the life of the patient In others it has insured a smoother convalescence. Please refer to Chapter III for more detailed discussion of the treatment of hemorrhage and the maintenance of fluid balance.

At the end of twenty-four hours after operation the packing, if used, is removed and any loose sutures are tied This is done in the patient's room. Thorough drainage is assured either through a suprapubic tube or an indwelling catheter Both the external wound and the bladder are irrigated daily with warm boric acid or potassium permanganate solution. The patient is thereby kept more comfortable and the danger of sepsis is minimized.

Uremic symptoms following prostatectomy in properly prepared patients are usually due to an ascending infection from the bladder brought on by disintegrating blood clots or incomplete drainage. The attack is ushered in by a

chill followed by high temperature, a diminished urinary output, and sometimes with delirium or coma The patient usually responds promptly to forced fluids and irrigations of the bladder

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The plane of cleavage between the false capsule of the prostate and the hypertrophied tissue is located by the tip of a pair of curved scissors. The index finger is then introduced and the enucleation continued as in suprapubic prostatectomy, extending the dissection first toward the apex of the gland (Fig. 637). If the urethra does not separate easily from the apex, it is divided with scissors. The apex of the gland is then delivered through the capsular incision and grasped with a tenaculum or sponge-holding forceps and the dissection is continued toward the bladder (Fig. 638). After releasing the gland from the bladder orifice any attachments or tags are excised. The prostatic fossa is packed with

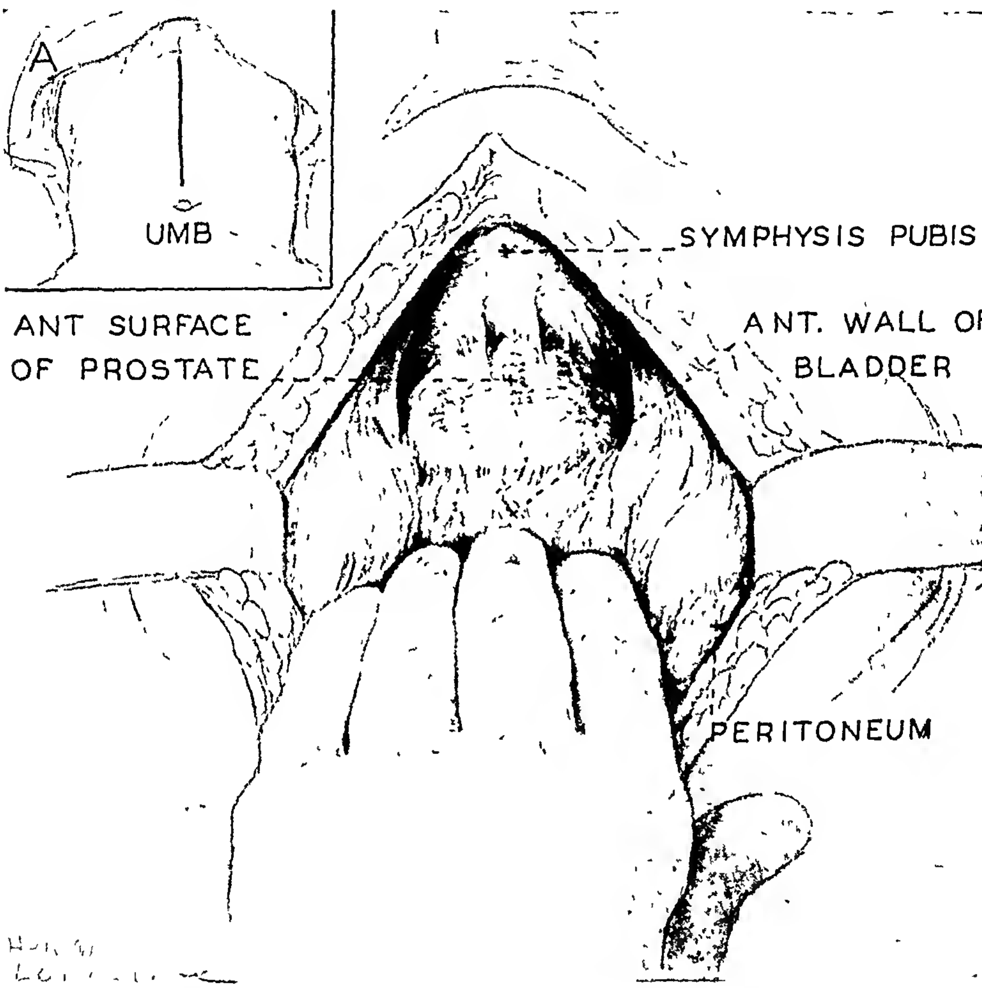

Fig 635—Retropubic prostatectomy Exposure of the prostate

gauze while the margins of the capsule and bladder orifice are examined If there are bleeding vessels they are clamped and ligated. A catheter is then passed into the urethra and its end guided through the bladder orifice. Millin uses a straight catheter Lowsley recommends a No 24 Foley catheter with the 30 c c. bag covered with Gelfoam soaked in thrombin. The tip of the catheter projects into the bladder. The bag is distended as necessary to make even pressure remain in the prostatic cavity. I have used a No. 20 F. catheter with a swath of oxidized gauze fixed to the catheter about two inches behind the tip.

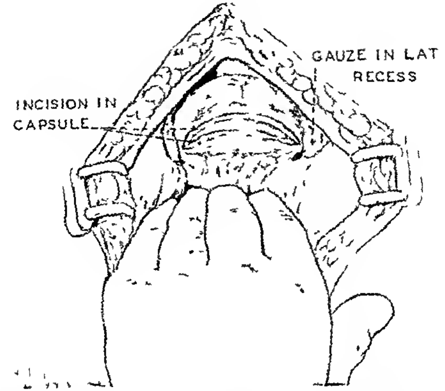

Fig. 636.—Retropubic prostatectomy Dorsal veins have been ligated and prostatic capsule has been incised

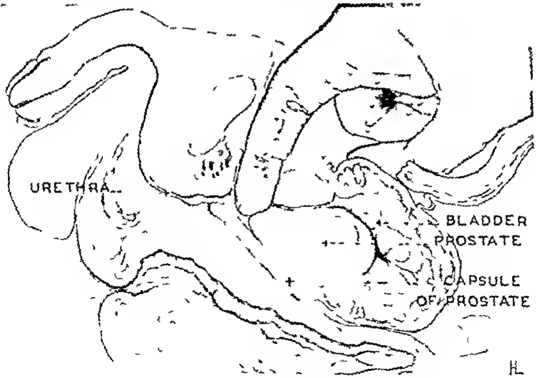

Fig. 637.—Retropubic prostatectomy Beginning enucleation at apex of the prostate

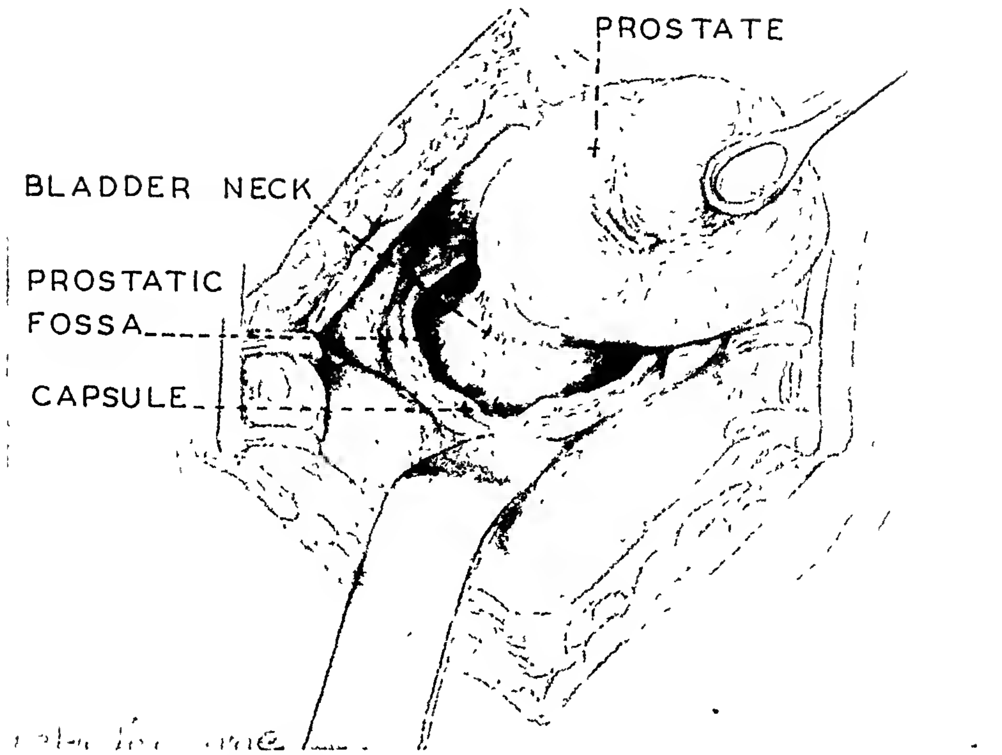

Fig. 638—Retropubic prostatectomy Prostate ready to be liberated from vesical neck

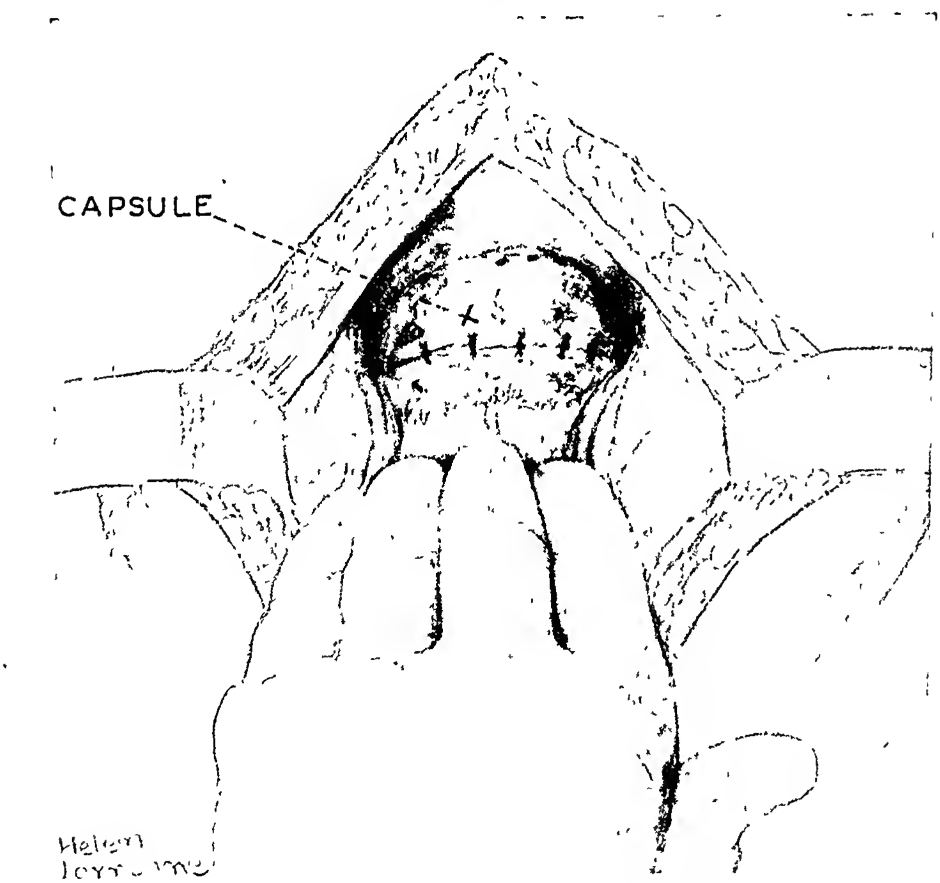

Fig. 639—Retropubic prostatectomy. Capsule is sutured.

The gauze remains in the fossa This has given adequate hemostasis and excellent drainage Mr Millin does not use a bag or hemostatic gauze When the catheter is in place the capsule is closed with continuous or closely placed sutures of 0 chromic catgut (Fig 639) Any ligatures that have been left long are tied together over the line of suture All gauze is removed from the wound and a small rubber tissue drain is placed in the space of Retzius The wound is closed as following one stage suprapubic prostatectomy

Mr Millin has devised a complete set of instruments including forceps, retractors, and boomerang needle holder Instruments in routine use can be substituted for them The surgeon is handicapped who depends too much upon specialized instruments

RADICAL RETROPUBIC PROSTATECTOMY

The complete removal of the prostate and seminal vesicles may be accomplished quite as readily and as completely by the retropubic method as by the perineal method The perineal operation has the advantage that in doubtful cases the prostate may be approached posteriorly and a biopsy done to determine the presence or absence of cancer before proceeding with the operation When the retropubic operation is done, the surgeon must depend upon palpation and/or needle biopsy which is not as accurate as biopsy under direct vision The retropubic operation in my opinion, in the hands of those accustomed to suprapubic or retropubic prostatectomy is less apt to result in urethrorectal fistula or incontinence

The operation proceeds as though a retropubic enucleation is to be done, until the anterior surface of the prostate is exposed The puboprostatic ligaments are palpated by the index finger and divided Beginning at the apex, the prostate is gently dissected from the rectum until the finger can be passed beneath the gland from both sides The urethra is then divided at the apex of the prostate, being careful to avoid cutting the catheter which was inserted previous to the operation The end of the catheter is withdrawn from the bladder and the two ends of the catheter are clamped with slight tension over the pubis thereby aiding in the control of bleeding The apex of the prostate is retracted upward and backward exposing the terminal portions of the vasa deferentia and seminal vesicles The vasa are divided and ligated and the seminal vesicles dissected free The prostate is then amputated from the bladder care being taken to preserve the ureteral orifices The closure may be made in one of several ways In most cases, the resulting bladder orifice may be reduced in size by suturing from above downward leaving the base of the trigone as the posterior lip of the bladder orifice This may be sutured to the stump of the membranous urethra with three or four sutures of chromic catgut or two stay sutures of No 1 chromic catgut may be placed just lateral to the bladder orifice and both ends carried through to the skin of the perineum on a large straight needle These sutures when tied over a piece of gauze, hold the bladder orifice snugly against the urethra The lumen of the urethra is kept in line with the orifice of the bladder by an indwelling catheter It is preferable to use a 30 c c Foley bag catheter which is pulled down snugly but not

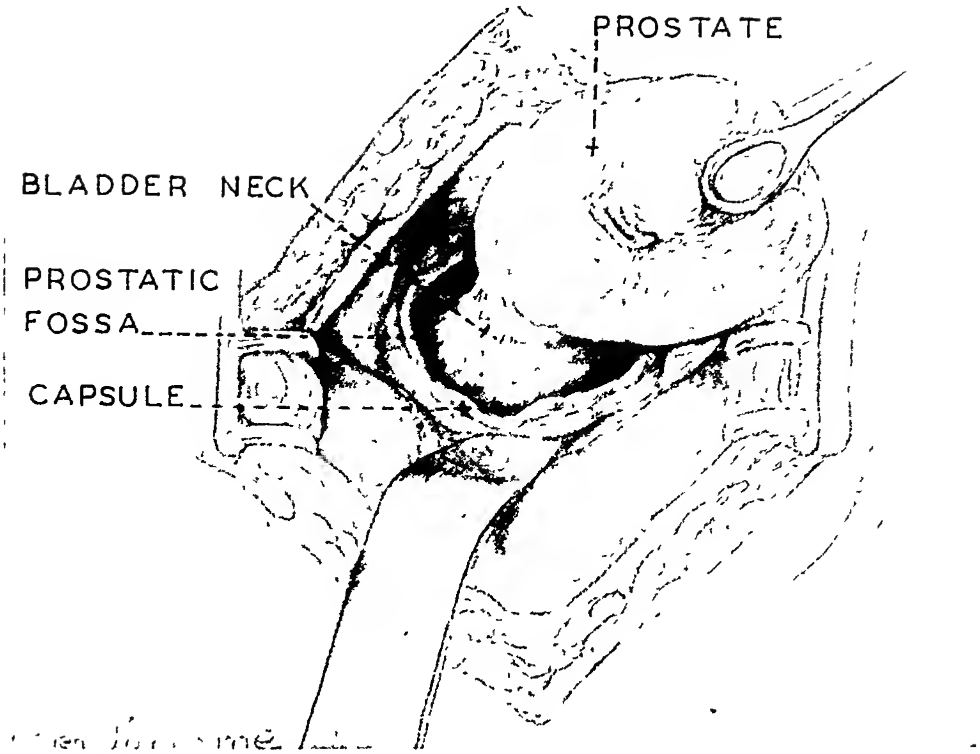

Fig 638—Retropubic prostatectomy Prostate ready to be liberated from vesical neck

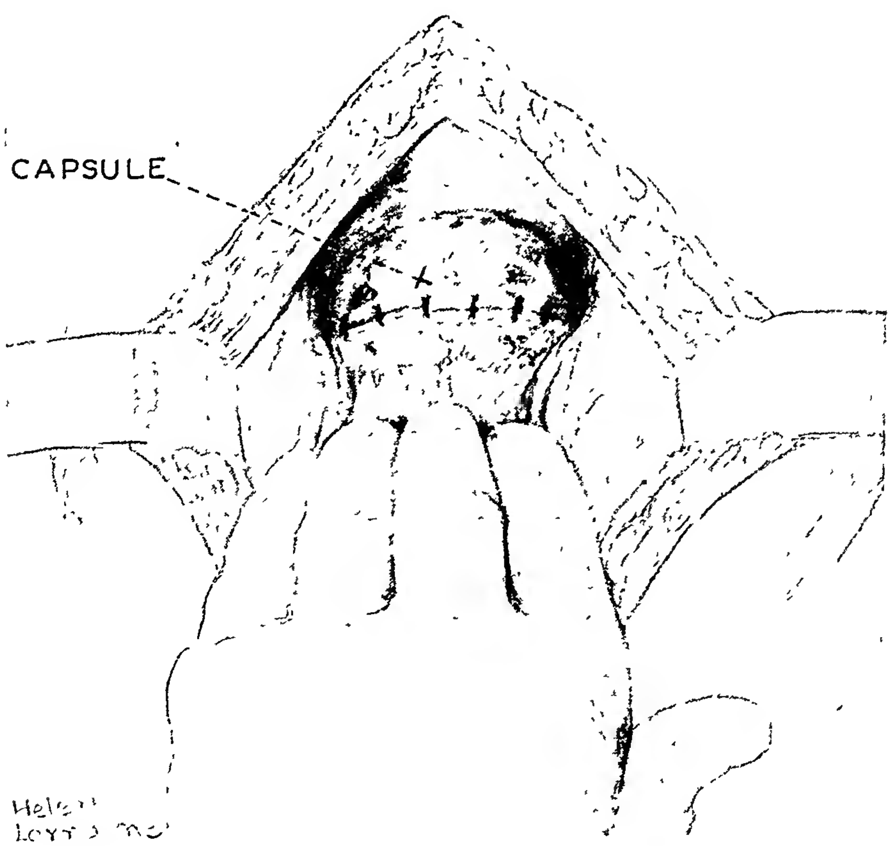

Fig. 639—Retropubic prostatectomy Capsule is sutured.

The possibility of other complications, such as its being a more difficult procedure, depends upon what effort a urologist has made to perfect the procedure

The possibility of urethrorectal fistulas can be considered in the same way

The chance of urinary incontinence can similarly be weighed, and the same holds true for the development of any type of fistula

We never consider perineal prostatectomy in young individuals or in patients who still are potent, except in cancer or poor risk patients, and then we feel it should be performed after a thorough explanation to the patient concerning the potency, otherwise, medico legal aspects will enter which might cause much embarrassment

The position of the patient is very important and while a special table is used by many, it is not absolutely essential Whichever way the patient can be placed in an exaggerated lithotomy position, whether it be by a special table or the perineum raised on sandbags, makes no difference Of most importance is to obtain the perineum in a position as parallel with the rest of the body as possible This is facilitated by having an arrangement that can set the legs back toward the head as much as possible The idea is to have the perineum as far forward as possible An antiseptic of either Argyrol or Zephiran solution is injected into the bladder The perineum and genitalia are prepared as for any other surgical procedure Sometimes we use special drapes, but this is not essential A sound, about F 22 or F 24 is introduced into the bladder after the patient is in position and held either by a special instrument or by an assistant In some cases we insert a long Lowsley seminal vesical tractor instead of a sound This forces the prostate forward and is left in until the prostatic urethra is exposed We use the ordinary sound as much as any

Landmarks should be marked before the incision is made They are the tuberosities of the ischium and a central point in the perineum, 2 cm above the anus A curved incision is then made through the skin, subcutaneous tissues and fat, as seen in Fig 640 We prefer to have the rectum clearly exposed when we reach that point Fig 641 demonstrates the anatomy of the structures in the perineum, but no longer do we attempt to expose all these structures We make every effort not to expose the bulbous and if possible the membranous urethra but to remain below and behind the transverse perinei In carrying this out, very little bleeding occurs and it certainly prevents urinary incontinence if one remains behind and below these structures Therefore after the initial incision is made, the central tendon is exposed One should develop the ischiorectal fossa on each side by inserting backward and downward the index finger of each hand until one feels a smooth surface covering a solid mass (Fig 642) This is the fascia of Denonvilliers over the prostatic capsule covering the prostate gland At this same time, one can approach the midline with his index fingers and feel a tubular structure which is the rectum covered by the central tendon One can easily insert the index finger between the rectum and central tendon and cut the tendon high (Fig 643) At this point the rectum is exposed, covered by the levator ani muscles

with force. When there is considerable tension between the bladder orifice and urethra, a tube flap can be made from the anterior surface of the bladder and joined to the membranous urethra by interrupted sutures of fine chromic catgut, as suggested by Flocks.

PERINEAL PROSTATECTOMY

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The Conservative Procedure

In selecting the surgical procedure that might best benefit a patient suffering with a prostatic disease, one must consider the following:

1. The patient with the disease
2. The condition of the patient with the disease
3. The training of the surgeon
4. The disease for which the operation is being performed.

No two patients should be fitted for the same operative procedure but rather the reverse—the best operation for the particular patient with the particular disease should be considered. There is no one operation that can possibly be offered to all patients if the most satisfactory result is to be obtained.

On the other hand, there are only a few urologists who can adeptly perform all five prostatic surgical procedures. This, of course, leaves much to be desired in the training of urologists. The one type of prostatic operation which is least performed not only in this country but throughout the world is the perineal procedure. It is certain that this procedure requires more careful technique and may be considered to be more difficult to perform. This is quite questionable. Nevertheless, if one is going to, as he should, consider the patient primarily, then it behooves all urologists to be trained to perform the perineal procedure. When the occasion arises where the perineal approach is desirable, then the patient is entitled to that benefit.

It is true that if we ever hope to cure cancer of the prostate or to prolong longevity in cases of cancer, the perineal approach offers by far the most benefit.

Cancer of the prostate is not the only disease for which a perineal approach to the prostate gland is the most suitable. In cases of fibrous prostates, calculi in the prostate, obese individuals, poor surgical risks, and the study of biopsy specimens for diagnosis, really the best service is offered to the patient if a perineal approach is considered. We readily recognize that wherever there are advantages there must be disadvantages; and they are as follows:

Practical loss of potency is by far the most important.

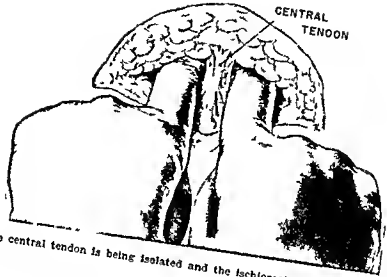

Fig 642 —The central tendon is being isolated and the ischiorectal fossae are beinฺ developed

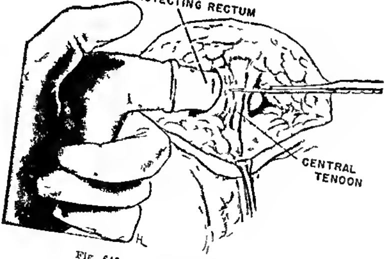

Fig 643 —Central tendon being cut

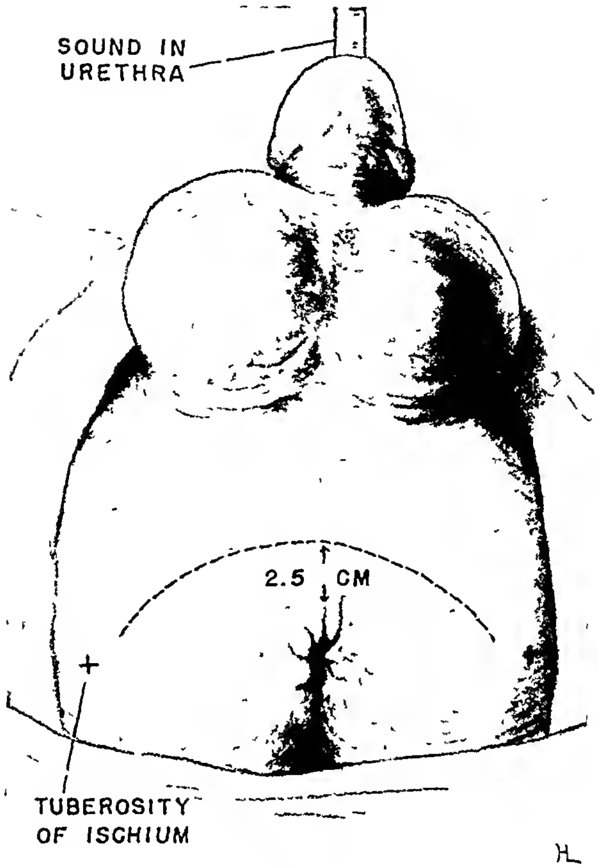

Fig. 640—Incision for perineal prostatectomy

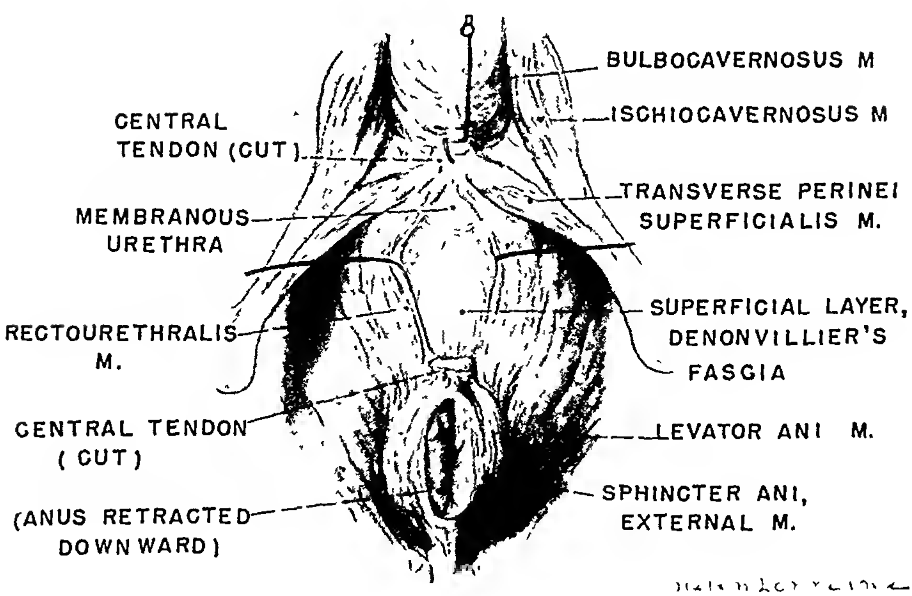

Fig 641.—Anatomy of male perineum

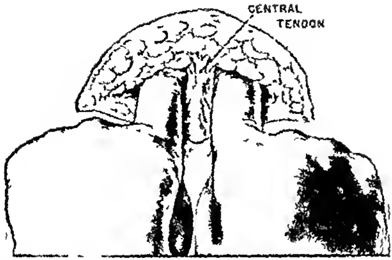

Fig 642 —The central tendon is being isolated and the ischiorectal fossae are being developed

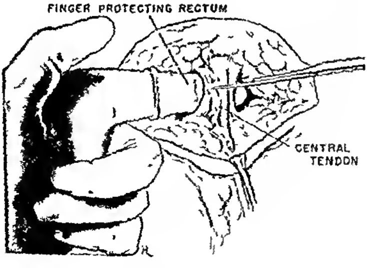

Fig 643 —Central tendon being cut

These are retracted. A procedure that we carry out at this point is to cover the entire rectum with a double folded gauze sponge and place the posterior retractor over it and gently pull downward. This pulls the rectum with it and exposes the rectourethralis fibers, some of which come along with the rectum. With this special maneuver there is no reason for injuring or perforating the rectum. (Fig. 644.) A light transverse incision about 3 cm. in length is made across the remainder of the rectourethralis fibers, which will enable a retraction of the remainder of the fibers. The folded sponge can be replaced several times. Place the posterior tractor over it and pull downward. This ultimately pulls all the rectourethralis fibers downward and frequently carries the fascia of Denonvilliers with it, exposing the prostate and its capsule (Fig. 645.)

This dissection can also be performed in a different manner by bluntly dissecting the tissues beginning at the membranoprostatic urethral region. Gently dissect the tissues downward and then apply the posterior retractor.

At this point, to expose the entire prostate for viewing, two narrow retractors are placed laterally and upward, one on each side, and a posterior tractor is placed over the rectum over a sponge.

Up to this point the membranous urethra has not been exposed, but the sound can be palpated at the membranoprostatic area or in the prostatic portion of the urethra.

If one is in doubt about the condition of the rectum at this point, or there are minimal adhesions of the rectum to the tissues covering the prostate, a finger may be inserted into the rectum to determine this condition. Should a perforation accidentally occur at this point, then no damage has been done, because it can immediately be repaired and the perineal approach discontinued Once an opening is made anywhere in the urethra and one is present in the rectum, there is every possibility for a fistula to form.

Assuming that no opening is in the rectum, a longitudinal incision one centimeter in length is then made with a scalpel over the sound in the prostatic urethra, making certain that the sound can be seen. The edges of the open urethra are now grasped with an Allis clamp on each side, making certain that the entire thickness of the wall of the urethra is grasped A Kelly clamp is now inserted into the bladder and the vesical orifice is dilated, permitting all the fluid to escape Either a Young or a Lowsley prostatic tractor is now inserted into the bladder with the blades closed When it is certain that the tractor is in the bladder, the blades are opened and the tractor is pulled outward and upward This brings the prostate closer to view. If the fascia of Denonvilliers has not been retracted posteriorly up to this time, a light transverse incision can be made at the apex of the prostate, by blunt dissection, strip the fascia downward. A sponge can now be placed over the fascia and rectum and held down by placing the posterior tractor over it (Figs. 645 and 646)

By making the urethrotomy incision in the prostatic urethra, every precaution has been taken to avoid incontinence, because this is behind the external sphincter.

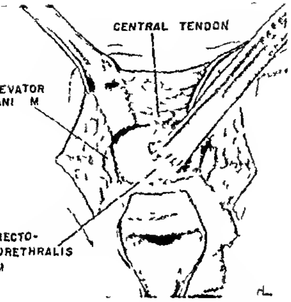

Fig 644—Rectourethralis incised and pushed down with knife handle

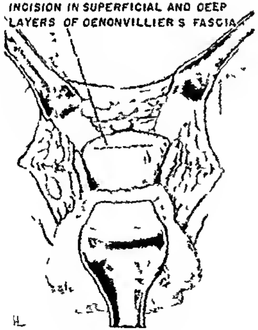

Fig 645—Incision in superficial and deep layers of Denonvilliers fascia

A transverse incision is now made through the capsule of the prostate, which may be thin or thick. No difficulty should be entertained in this process because the prostatic tissue will be visible to the naked eye as grayish in color. The incision is about 2 to 2.5 cm. in length, half on each side of the urethrotomy incision, making it in reality an inverted T-incision. (Fig. 647.) At times we make a lateral incision on each side of the urethrotomy but lower, below 1½ to 2 cm. in length. We prefer the transverse incision.

With the blunt dissector or scissors, the prostatic capsule is dissected away from the prostate on each side and then the dissection is continued with the finger encircling the prostate and the prostatic urethra but remaining extravesical. This procedure is performed above and below the transverse prostatic capsular incision. At this point the urethra is severed at the junction of the prostatic and membranous urethra. This permits one to pull the prostatic

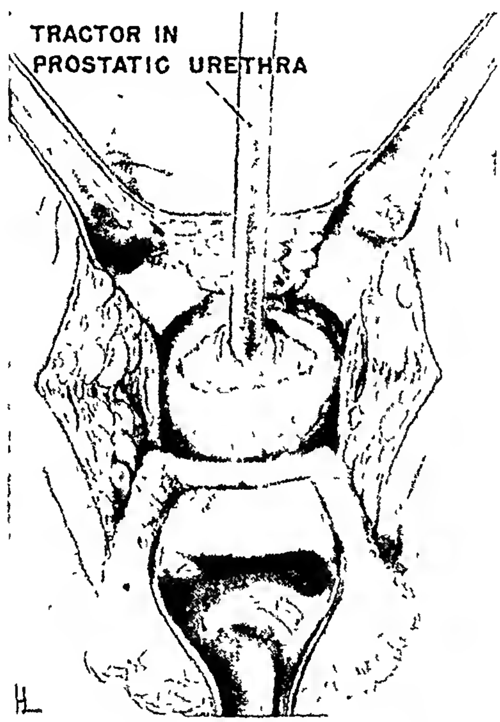

Fig. 646—Urethrotomy in prostatic urethra

tractor with the prostate encircling it in an outward position and the only structure attached to the prostate is the vesical neck which is attached to the prostatic urethra. This can be viewed with the naked eye. By sharp dissection the entire mass is cut away from the prostatic urethra after the vesical neck is grasped, cutting close to the prostate. (Figs. 648, 649, and 650.)

The blades of the prostatic tractor are now closed and the prostate is delivered *en masse*, encircling the instrument. If any bleeders are observed at the vesical neck they can be ligated. As a rule there are none. A No. 20 Foley catheter 30 c.c. bag is now inserted into the penis and seen coming through the membranous urethra. It is directed into the bladder which is being held between Allis clamps. If the internal vesical orifice seems tight, a

wedge-shaped piece of tissue can be removed posteriorly or the vesical orifice can be dilated with a Kelly clamp. The tip end of the catheter is passed into the bladder. The bag is distended and pulled forward. The cavity from which the prostate has been dissected and removed is readily observed. There is no attempt made to anastomose the membranous urethra to the vesical orifice except in radical procedures (Fig 651). The longitudinal incision in the prostatic capsule for the urethrotomy may or may not be sutured. If sutured we use interrupted chromic catgut No 1. The transverse incision in the prostatic capsule is closed with a continuous chromic catgut No 1 to make it a watertight closure. This is going to form the new floor of the urethra. When this procedure is completed the area has the appearance similar to that before the prostate was removed (Fig 652).

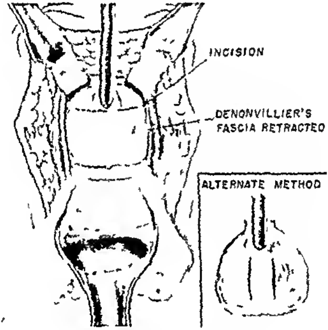

Fig 647.—Incision in prostatic capsule

The bladder is irrigated several times to evacuate any clots if present. One suture of chromic catgut No 1 is taken across the levator ani muscles.

The rectum is examined at this point.

One empty Penrose drain is inserted into one angle of the wound and the skin is closed with either a subcutaneous catgut No 1 or interrupted black silk suture (Fig 653). A light dressing is applied and held together with a perineal pad.

A bilateral partial vasectomy is performed in all cases, either before the prostatectomy or after, depending upon the condition of the patient.

The operation described by Belt, Ebert and Surber uses the cleavage plane between the longitudinal muscle fibers of the rectum and the external sphincter ani muscle to expose the external capsule of the prostate.

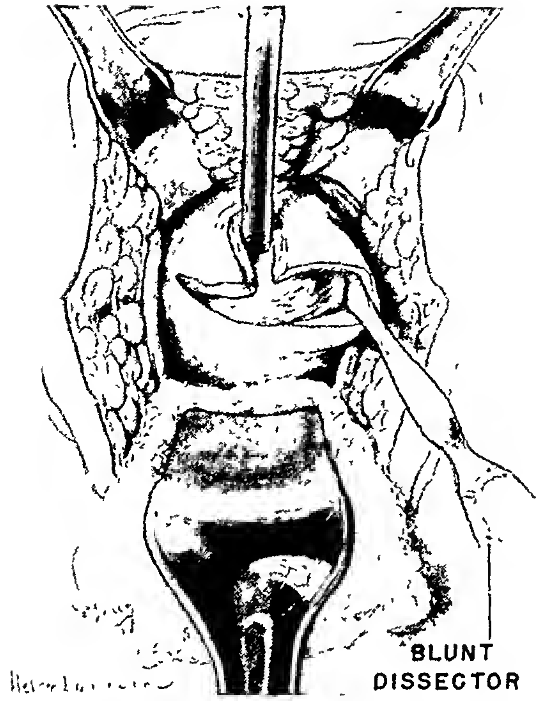

Fig 648—Dissecting the lateral lobes

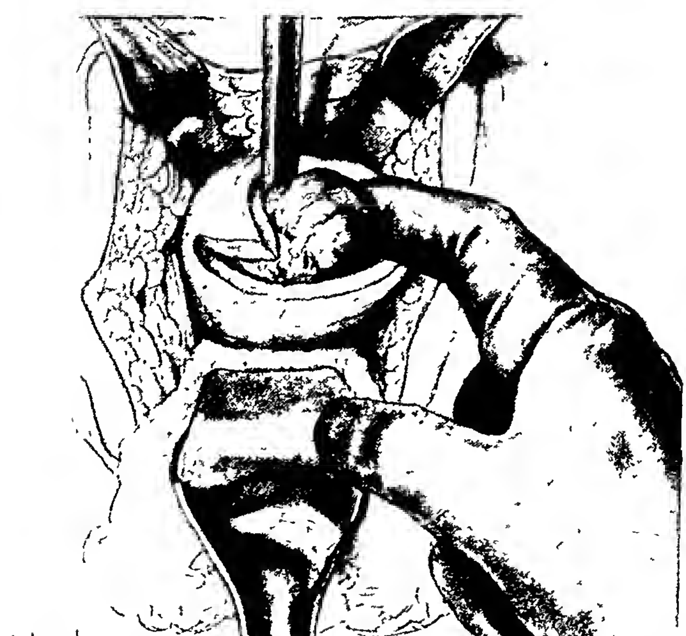

Fig. 649.—Enucleating the entire prostate, with aid of finger

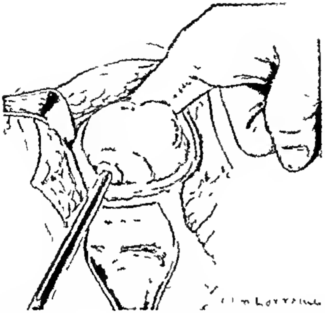

Fig 650—The entire prostate being enucleated around the prostatic tractor

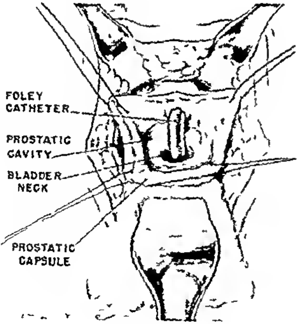

Fig 651—Catheter in urethra and bladder Exposure of prostatic bed

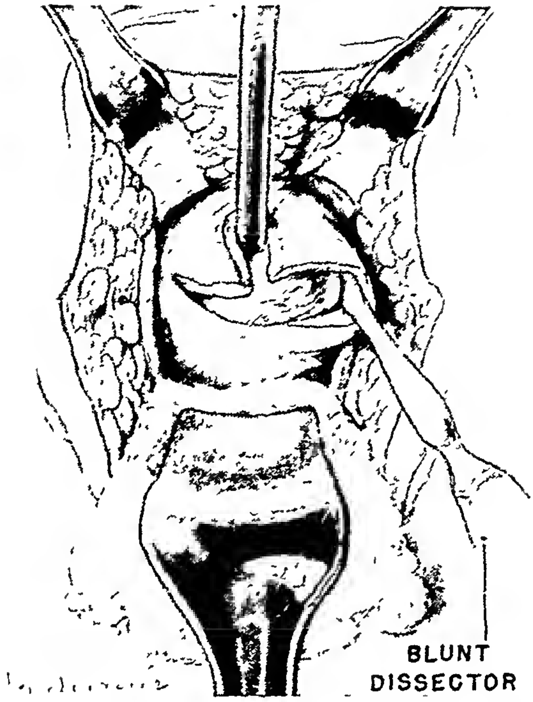

Fig. 648—Dissecting the lateral lobes

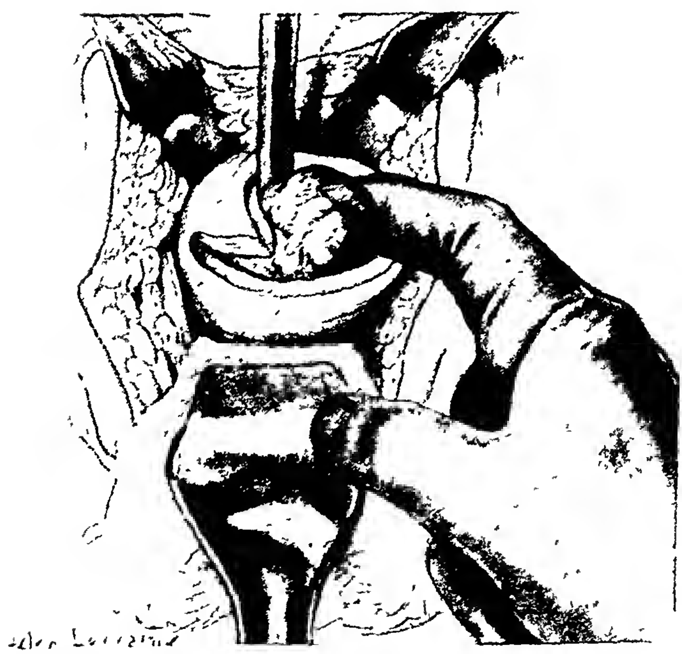

Fig. 649.—Enucleating the entire prostate, with aid of finger

The preparation and position of the patient on the table are the same as for Goldstein's operation The incision through the skin extends as a semicircle from one ischial tuberosity to the other and is placed on a radius about 1 5 cm from the anal mucosa (Fig 654) The lower wound margin is depressed backward by the aid of dry gauze beneath the fingers of the left hand The fibers of the median raphe which are thus made to stand out are divided (Fig 655) The handle of the knife can then be inserted beneath the fibers of the external sphincter which can be seen close to the skin of the lower flap (Fig 656) The external sphincter is easily separated and retracted forward exposing the longitudinal fibers of the rectum which can be followed to the apex of the prostate (Fig 657) At the apex of the prostate the free interior borders of the levator ani muscles are almost in apposition ("rectourethralis" muscle) By depressing the rectum with the left forefinger these muscles stand out prominently The handle of the knife can be inserted between the muscle borders and lateral pressure made to first one side and then the other, exposing the fascia covering the posterior surface of the prostate

A sound is inserted through the urethra into the bladder By making forward and downward pressure against the handle of the sound the posterior surface of the prostate is more completely exposed The rectum is held away from the operative field by a posterior retractor

An inverted U shaped incision is made through the prostatic capsule The transverse part of this incision is placed just peripheral to the verumontanum This point is just proximal to the membranous urethra in the prostatic capsule

The flap outlined by the U shaped incision is liberated and pressed backward carrying with it a small triangle of the urethra containing the verumontanum included in the flap The sound is exposed at the apex of the prostate and the adenomatous nodules can be seen bulging into the posterior urethra The posterior (dorsal) aspect of the urethra is carefully isolated and cut off as it leaves the hypertrophied prostatic nodules to join the membranous urethra The adenomatous nodules are bluntly dissected from the capsule of the prostate by the finger, carefully keeping to the cleavage plane between the adenomatous tissue and the capsule

The sound is then withdrawn and a catheter is introduced through the opening in the posterior urethra and the bladder contents (urine and antiseptic solution) are evacuated The catheter is discarded and the remaining (anterior or ventral) portion of the urethra is divided at the apex of the prostate, completely severing the urethra

A prostatic tractor is then passed through the prostatic urethra into the bladder and opened Gentle traction is made on this tractor while liberation of adenomatous portion of the prostate from the capsule and bladder orifice is continued

As the lobes are mobilized they are grasped by thyroid forceps and pulled toward the operator A cone of the bladder neck is pulled forward with the prostate and is stripped backward by blunt dissection, carefully preserving the circular muscle fibers of the bladder neck When a cylinder of posterior urethral mucosa is reached it is cut off with scissors, completely liberating the adenomatous

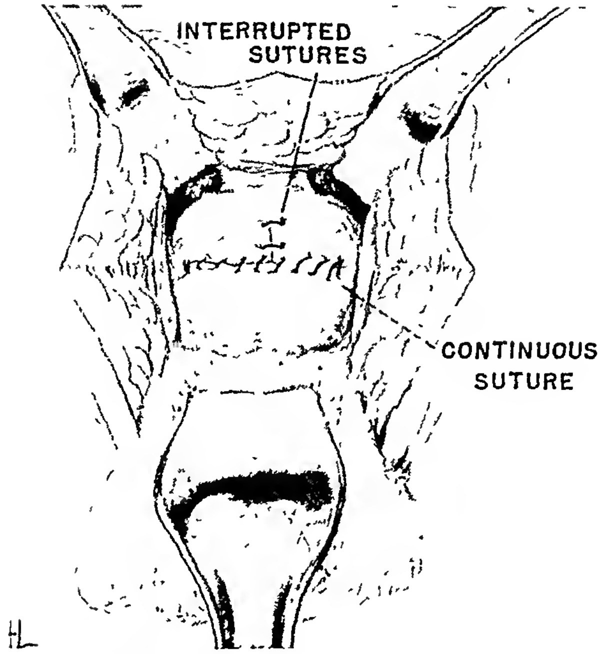

Fig. 652—Closure of inverted-T incisions

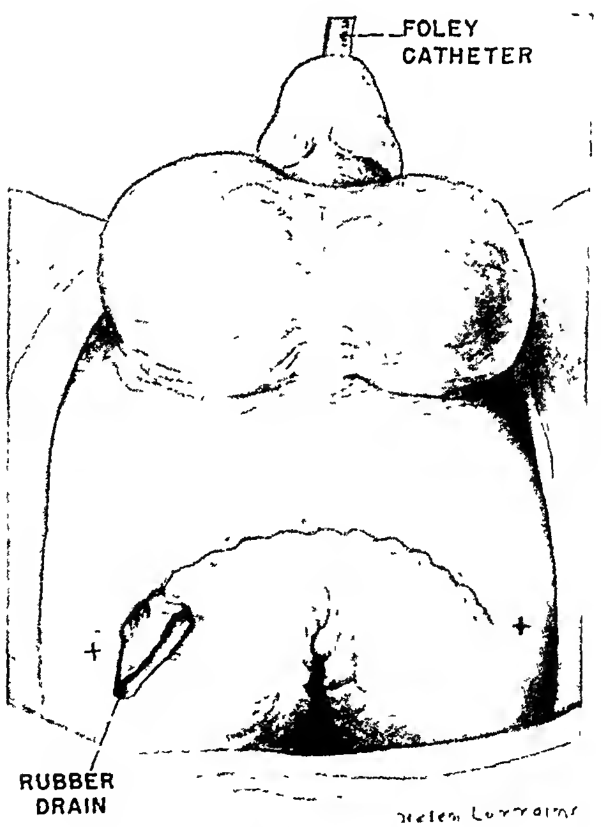

Fig 653—Closure of perineal wound

The preparation and position of the patient on the table are the same as for Goldstein's operation The incision through the skin extends as a semicircle from one ischial tuberosity to the other and is placed on a radius about 1 5 cm from the anal mucosa (Fig 654) The lower wound margin is depressed backward by the aid of dry gauze beneath the fingers of the left hand The fibers of the median raphe which are thus made to stand out are divided (Fig 655) The handle of the knife can then be inserted beneath the fibers of the external sphincter which can be seen close to the skin of the lower flap (Fig 656) The external sphincter is easily separated and retracted forward exposing the longitudinal fibers of the rectum which can be followed to the apex of the prostate (Fig 657) At the apex of the prostate the free interior borders of the levator ani muscles are almost in apposition ("rectourethralis" muscle) By depressing the rectum with the left forefinger these muscles stand out prominently The handle of the knife can be inserted between the muscle borders and lateral pressure made to first one side and then the other, exposing the fascia covering the posterior surface of the prostate

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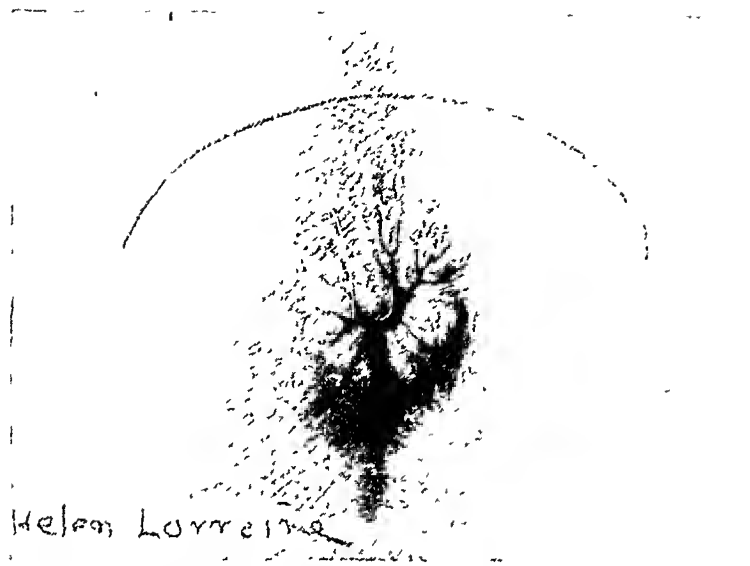

Fig. 654.—A new anatomic approach in perineal prostatectomy The line of incision 1 5 cm from the rectal mucosa.

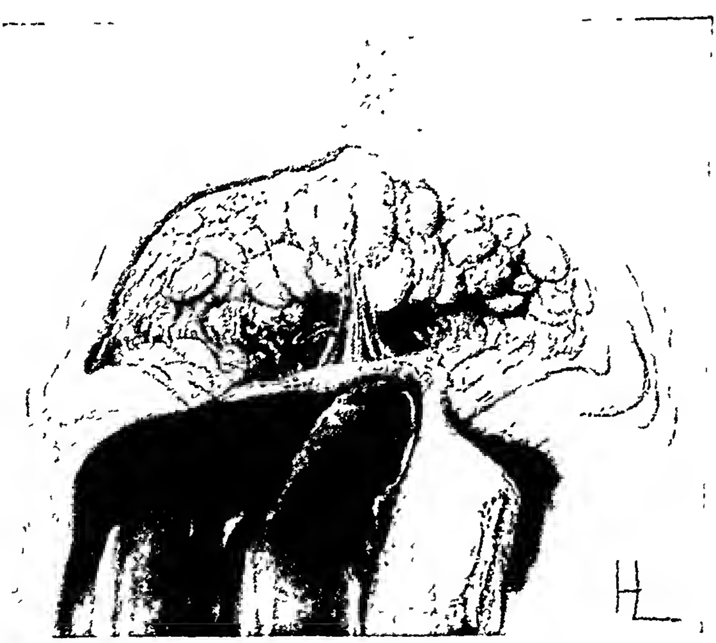

Fig 655—Skin incision Superficial skin flap pulled down, stretching fibers of median raphe before they are cut.

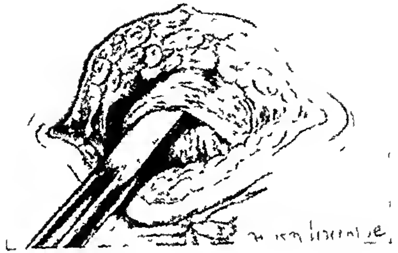

Fig 656.—Cleavage plane between external sphincter ani muscle and rectum

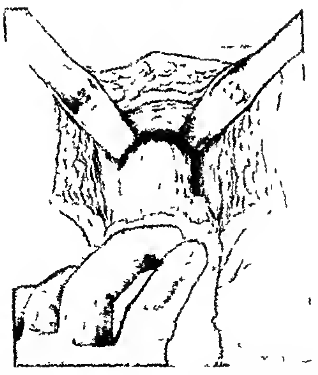

Fig 657.—External sphincter ani muscle retracted upward disclosing approach to the prostate The rectum bulges into the lower portion of the wound above The median portion of the levator ani muscles cover the apex of the prostate From this point the operation may proceed as in Figs 644-653 except that *in the operation by Belt* a U shaped incision is made in the prostatic capsule and the bladder orifice is anastomosed to the membranous urethra

prostatic tissue. As the posterior urethral mucosa is divided the proximal stump should be grasped with an Allis clamp to prevent the bladder orifice from retracting out of sight. When a large middle lobe necessitates carrying the cut high up across the trigone, Allis clamps are applied to each side of the bladder neck. Spurting vessels around the bladder orifice or on the side of the bladder within the capsule are transfixed by catgut on a small round needle and ligated. The neck of the bladder and capsule are carefully examined and any remaining adenomas or tags of tissue are trimmed away. A two-hole 24 F. catheter is then introduced through the urethral meatus and made to emerge from the cut end of the urethra inside the capsule. It is then pulled out of the wound and retracted upward by a narrow retractor, exposing the cut end of the urethra. A chromic catgut stitch is taken through the ventral border of the urethra, carried through the ventral border of the bladder neck, tied and cut. The free tip of the catheter is then introduced into the bladder and the anastomosis of the urethra to the bladder orifice is completed by placing sutures laterally and posteriorly.

In closing the prostatic capsule an attempt is made to close the dead space between the bladder and the capsule A stitch of No. 2 chromic catgut is taken at each lower corner of the capsule, which includes some bladder tissue, and emerges through the central flap The flap is then sutured to the capsule by five interrupted sutures of No. 2 chromic catgut. When the sutures are tied the structures are brought back to their original anatomic position. The medial portion of the pubo-coccygeal fibers of the levator ani muscles are brought together by three sutures of No. 2 chromic catgut. A Penrose drain is placed in the space between the rectum and the prostatic capsule and brought out at one angle of the wound. The edge of the external sphincter is approximated to the longitudinal fibers of the rectum with a purse-string stitch of No. 2 chromic catgut. The superficial fascia is closed with interrupted sutures of plain catgut and the skin is closed with a continuous subcuticular stitch of plain catgut. The bladder is irrigated, all clots are removed and the catheter is strapped in for drainage. The wound is dressed with a moist antiseptic dressing The Penrose drain is removed in 24 hours.

RADICAL PERINEAL PROSTATECTOMY FOR CARCINOMA

Since carcinoma of the prostate gland is the most prevalent one in the male and is accountable for over 10 per cent of all the deaths occurring in this country, it behooves all of us to make some concerted effort to eradicate this disease.

If we hope at any time to cure this disease, it has been demonstrated that we must make the diagnosis early and then act as quickly and efficiently as possible. Since the disease occurs in men over 50 years of age and has been estimated to be present in between 13% and 22% of all men beyond this age, one cannot help but feel its importance.

These figures vary considerably. In a recent survey at Baltimore Levindale Hospital (For the Aged and Infirm) 84 male patients were examined. All were over 50, with an average of 72 years. Only one case of carcinoma of the

prostate was detected by a digital examination At this same institution there has not been a death from carcinoma of the prostate in 14 years, yet, in this same period, over 50 of the patients have had a prostatectomy

Again, since the largest percentage of cases occur in the posterior lobe, the simplest test for diagnosis is the digital examination of the gland through the rectum While a few other tests, principally the study of a biopsy specimen, can verify the diagnosis, every effort should be made early to arrive at a definite diagnosis The growth and spread of the disease is slow and varies in different individuals therefore the necessity of attacking the disease early

The experience of all urologists reveals the fact that, if we ever hope to cure carcinoma of the prostate gland, it must be attacked surgically and completely when the lesion is small By "small" is meant a lesion no larger than one centimeter in diameter

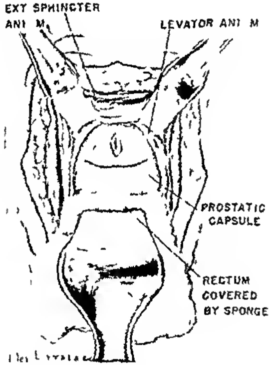

Fig 658 —Belt exposure of prostate for perineal prostatectomy Belt suggests an inverted U shaped incision in the prostatic capsule

In an effort to cure some of these patients with carcinoma of the prostate, the late Dr Hugh H Young perfected and popularized a procedure in 1904 When this procedure is carried out by way of the perineum and includes areas which tend to accept a spread of the disease, such as the seminal vesicle and its surrounding fascias the neck of the bladder and sometimes part of the urethra, it has resulted in increasing the life expectancy of the individual The procedure is known as the radical perineal prostatectomy Several modifications of the procedure have been suggested by Goldstein, Elmer Belt (Figs 654 658), and others but in principle are the same The modifications have been suggested principally to simplify the procedure, and avoid urinary

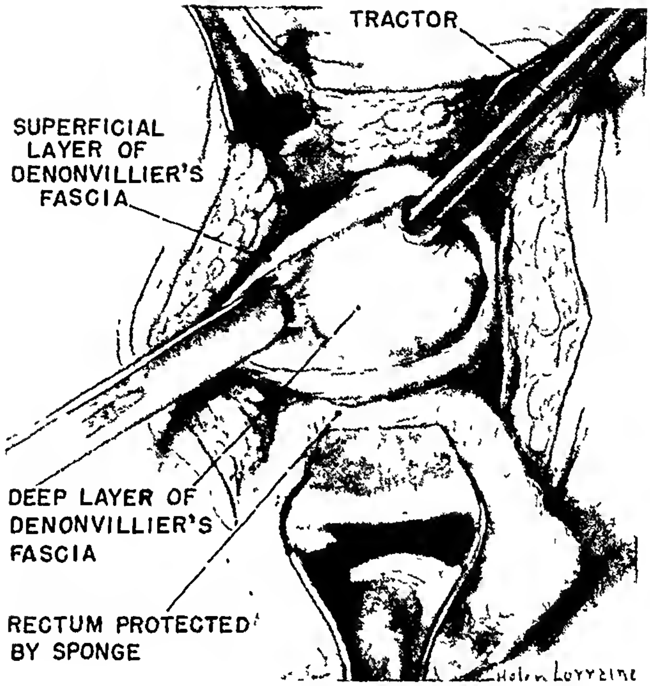

Fig 659 —Separating prostate in radical prostatectomy.

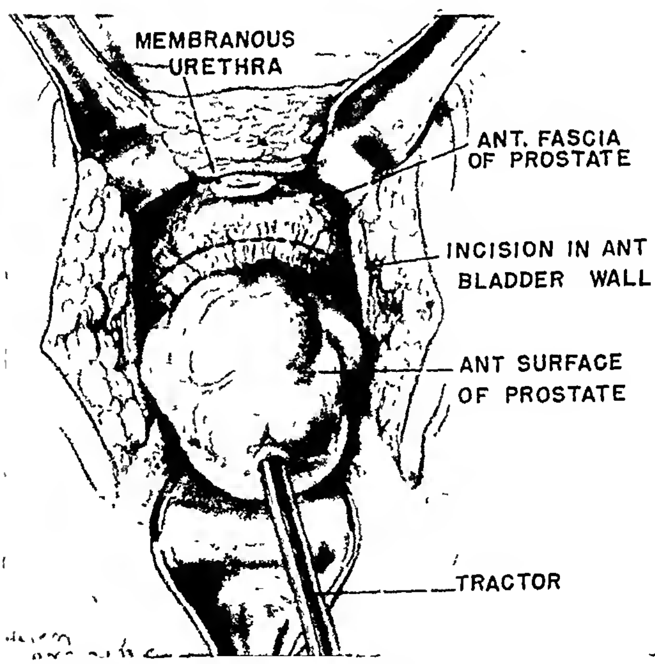

Fig 660 —Incision in bladder neck, for complete removal of prostate, etc, in radical perineal prostatectomy

incontinence In our own experience, incontinence has remained permanently in only 2%, while temporary incontinence has occurred in 12 per cent The temporary incontinence disappeared in from three to fifteen weeks

The procedure is carried out primarily as described in performing the conservative perineal prostatectomy, with the addition that through the same incision the seminal vesicles, portions of each vas deferens together with the capsule of the prostate, the bladder, and sometimes a small section of the urethra are removed, all in one section (Figs 659-662) At the completion of this excision there is a deficiency of the urethra This then is anastomosed to the neck of the bladder over a catheter The anterior portion of the urethra is brought together with the anterior portion of the vesical neck by taking two

Fig 661 —Exposure of bladder in radical perineal prostatectomy Prostate removed with other structures

sutures of chromic catgut No 1 through both of these structures Then the anastomosis is completed by taking several sutures of the same material through the posterior portion of the urethra and vesical neck This makes a watertight anastomosis which heals very rapidly with very little drainage (Goldstein) (Fig 663) The catheter is removed in 10 to 12 days and the patient voids immediately In 88% of our cases there was perfect control of urination either immediately or in two to four days

To one who is trained or has been trained in the perineal route, the procedure is not difficult The average time for completing a procedure ranges from 90 to 150 minutes There is very little loss of blood, averaging less than

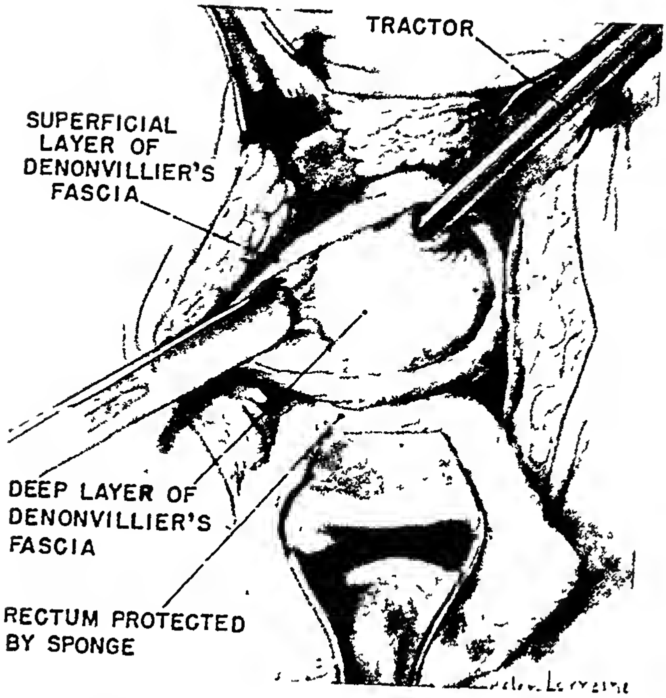

Fig. 659 —Separating prostate in radical prostatectomy.

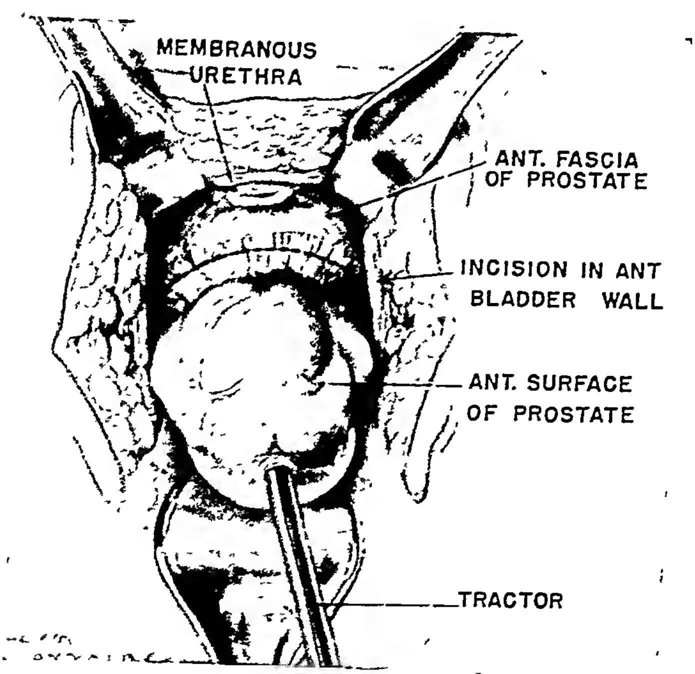

Fig 660 —Incision in bladder neck, for complete removal of prostate, etc., in radical perineal prostatectomy.

500 c c as worked out by Goldstein and Rubin, and Goldstein, Golden, and Silverstein It is attended by very little shock The patient is usually up on the third postoperative day and walking by the sixth postoperative day The average stay in the hospital is about 19 days In our experience the procedure has been complicated by a rectourethral fistula in one case No perineal fistulas have occurred One must be careful about the question of impotence, particularly in younger men This must be thoroughly explained before the operative procedure, otherwise, embarrassing medico legal complications may arise

All of our cases have resulted in impotency, if it were not present previously The question of diagnosis is of extreme importance, therefore, no radical procedure is attempted without a perineal biopsy Much embarrassment can be avoided if this is carried out as shown by Goldstein Jewett claims that about 46 per cent of all nodules palpated by the digital examination which were thought to be malignant nodules proved to be benign at the time of a biopsy study of a section from the prostate at the time of operation This is extremely important and shows the necessity of performing biopsies before operation

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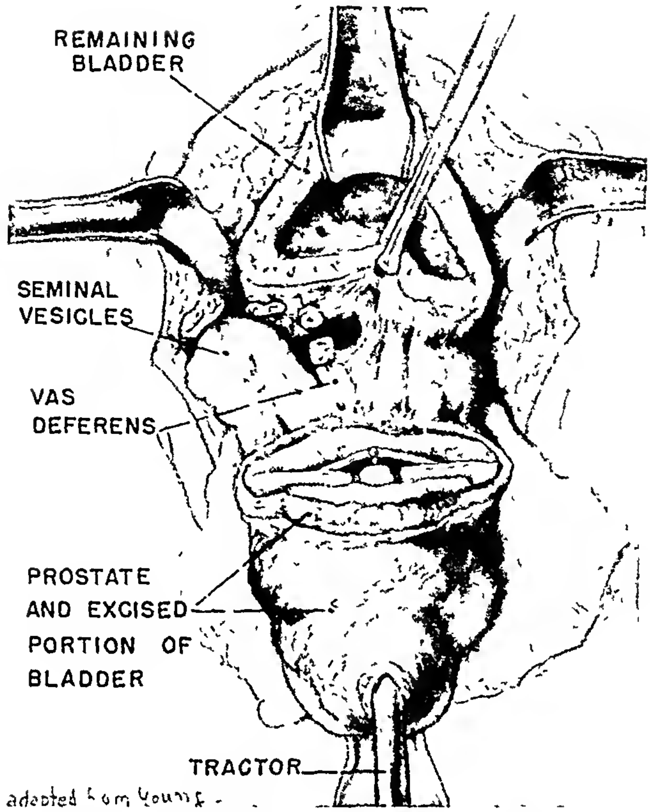

Fig 662—Completion in radical perineal prostatectomy, including seminal vesicles and vas deferens

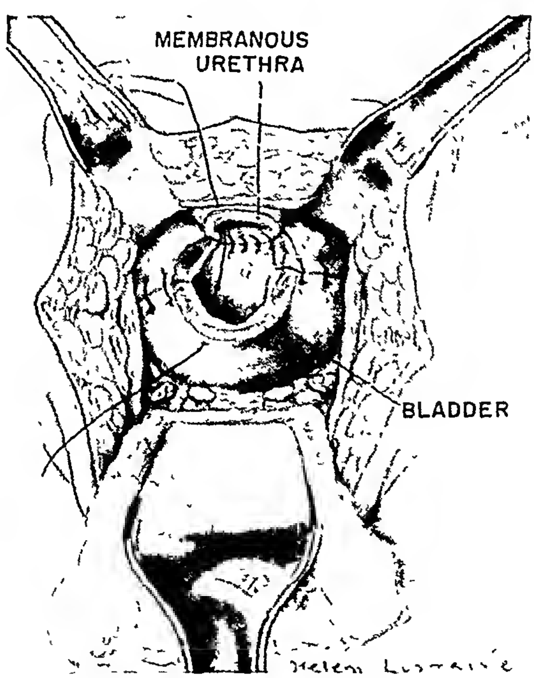

Fig 663.—Anastomosis of membranous urethra to vesical orifice

CHAPTER XLIV

POSTOPERATIVE URINARY INCONTINENCE

Persistent incontinence of urine is an infrequent but very troublesome complication of prostatectomy Quite frequently there is temporary dribbling when voiding is first resumed, but in most cases complete control is established within a few days The hypertrophied bladder wall which is often associated with prostatic hypertrophy may be out of balance with the sphincter mechanism following prostatectomy, and for a time causes the patient to have difficulty in controlling his urine Tags of tissue and prostatic nodules that are left in the prostatic cavity predispose to infection and irritability of the bladder, which is a definite factor in moderate degrees of postoperative incontinence Distortion of the internal sphincter and posterior urethra by scar tissue may cause some degree of incontinence Neurological disease of the bladder unrecognized at the time of operation may also cause incontinence following prostatectomy

Complete incontinence is caused either by injury of the sphincter mechanism or its nerve supply during operation or by wound infection and the formation of extensive scar tissue following operation Either the internal or external sphincter will control the urine In most cases of suprapubic prostatectomy or transurethral resection the internal sphincter is destroyed or seriously impaired, yet complete incontinence is a rare complication of suprapubic prostatectomy In this operation the external sphincter is not disturbed Following transurethral resection incontinence occurs more frequently This is accounted for by damage to the external sphincter by cutting too far forward, by excessive coagulation in the anterior portion of the prostatic urethra, and doubtless at times by over stretching or rupturing the membranous urethra by the use of large instruments In properly performed perineal prostatectomy the external sphincter is not injured and it is often possible to preserve the internal sphincter, yet some degree of postoperative incontinence is more frequently reported than following any other type of operation Incontinence may result from injury to the external sphincter or its nerve supply Young found that in all cases examined with complete incontinence, both internal and external sphincters were dilated and there was failure of the musculature in those regions to prevent the outflow of urine

Treatment—The patient who is unable to control his urine following a prostatectomy is always considerably disturbed and often quite despondent It is helpful to advise him beforehand that voiding will probably not be satisfactory for a few days when bladder function is resumed He should be told to expect some frequency, burning and dribbling of urine Often the urgency that causes the bladder to empty before a urinal can be reached is mistaken for incontinence, but if *there is no dribbling* between times normal bladder

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left intact over the anterior surface of the urethra and for a short distance downward on each lateral wall The denuded area is then sutured together from side to side, using from four to six interrupted sutures of chromic catgut The denuded margins of the dilated urethra and anterior part of the trigone are thus approximated, leaving in front a rather tight urethral orifice The wound in the anterior wall of the bladder is then closed with a Pezzer catheter in the upper end to drain the bladder The abdominal wound is closed with the drainage tube emerging near the upper end

The patient is then placed in the exaggerated lithotomy position, as for perineal prostatectomy A sound is passed into the urethra and a vertical incision is made in the perineum The incision is carried down to the membranous urethra and posterior part of the bulbous urethra All scar tissue is dissected away until healthy muscle is exposed on both sides of the wound The posterior portion of the bulbous and the membranous urethra is opened and the redundant part of the urethral wall is excised, so reducing the caliber of the urethra The urethra is closed with a continuous suture of plain catgut The muscle from each side of the wound is then approximated over the urethra by a continuous suture of No 2 chromic catgut The fascia and subcutaneous tissues are approximated by a continuous suture of the same material The skin is closed by a subcuticular catgut suture, leaving a small area at the anterior angle of the wound for a small rubber drain

Postoperative Treatment—The bladder is drained suprapubically for about three weeks During this time the bladder is irrigated daily with a mild antiseptic solution to prevent encrustations in and around the tube Urinary antiseptics and acidifying drugs are administered as indicated About three weeks following the operation a filiform is passed and the urethra is dilated gently with Le Fort sounds A small catheter, about 14 F, should be tied in the urethra and the suprapubic tube removed When the suprapubic wound is healed, the urethral catheter is removed It may be necessary to continue weekly urethral dilatations for several weeks until the tightly closed sphincters obtain normal elasticity

Lowsley Hunt Operation—The patient is placed in the lithotomy position and a No 20 F sound is passed into the urethra A median incision is made in the perineum and carried through the fat and Colles' fascia, exposing the bulbocavernosus muscle The muscle is dissected free on all sides and plicated by three sutures of chromic ribbon gut studded with atraumatic needles The plication sutures are placed well down on the lateral surface of the muscle, then fixed in a similar position on the opposite side, pulled tightly across the posterior surface and tied The sound is then removed The fascia is closed with a continuous suture of plain catgut and the skin with interrupted nonabsorbable sutures

Transplantation of the Gracilis Muscle for the Cure of Incontinence in the Male as Described by Player and Callander—The patient is placed in the extreme lithotomy *position* Preparation of the field of operation includes the perineal region and the entire thigh and knee on the side from which the muscle

function may be expected within a few days. Control when in bed but incontinence when on the feet is usually corrected by encouragement and training. If the bladder is filled with an antiseptic solution two or three times a day and the patient encouraged to interrupt the stream several times while the bladder is being emptied, control is more rapidly regained. The same exercise should be taken whenever the bladder becomes sufficiently full to permit the patient to void. When there is considerable dribbling, a clamp of the Cunningham type may be worn and the patient instructed to remove the clamp and exercise the sphincter muscles whenever there is a desire to void. The wearing of a urinal should be discouraged as long as there is hope of regaining control. Once the urinal is attached, most patients discontinue all efforts to control the urine and resign themselves to a life of incontinence. Antispasmodic drugs are often helpful in decreasing the tone of the detrusor muscles and in alleviating mild degrees of incontinence. Ephedrine and belladonna combined are particularly useful. The passage of sounds at weekly intervals is helpful in ironing out irregularities in the channel and in decreasing the rigidity of scar tissue. If incontinence persists for more than a few weeks, a thorough cystoscopic examination should be made and any obstructive lesions, such as bars, prostatic nodules or tags of tissue, should be removed by resection or punch operation. Incontinence that persists after healing is complete is apt to be permanent unless it can be relieved by an operation to tighten the sphincters or by transplanting a muscle to serve as an accessory sphincter.

Operations for the Cure of Incontinence.—H. H. Young has devised an operation for incontinence of urine, consisting of a combined plastic procedure on the internal and external sphincters of the bladder. Scar tissue is excised, the lumen of the urethra is reduced, and the muscles are sutured snugly over the sphincter areas.

Lowsley plicates the bulbocavernosus and ischiocavernosus muscles with ribbon catgut which has the effect of constricting the bulbous urethra and improving urinary control.

Player and Callander transplanted the gracilis muscle and sutured it around the bulbous urethra in a manner similar to the operation described by Deming in the treatment of incontinence in the female. Satisfactory control was obtained. Abeshouse has also reported the relief of incontinence by this method.

Young's Operation.—The patient is placed in the Trendelenburg position and the bladder is exposed by a suprapubic incision. An ample incision is made in the anterior wall of the bladder and the wound widely retracted so that the bladder orifice is easily accessible. The mucous membrane of one side of the bladder orifice is picked up with forceps and dissected off with scissors. The dissection is continued until the lateral and posterior margins of the dilated orifice are denuded. The incision is carried fairly deep, excising all the scar tissue and exposing the muscles. The dissection should extend from the surface of the bladder well into the posterior urethra, leaving a fairly widely denuded area with the surface composed of muscles The mucous membrane is

In March, 1951 Dr Albert Verges Flaque described an operation in which the external anal sphincter was utilized as a substitute for the external urethral sphincter.

Technique.—The patient is placed in the lithotomy position. An inverted Y incision is made, the vertical stem extending from the perineal scrotal junction to a point about 2 cm above the anus, and the curved branches extending halfway around the anus. This is deepened through the subcutaneous fat and fascia, and the rectal sphincter exposed. The anterior circumference of the sphincter is isolated by sharp and blunt dissection, and the central tendon

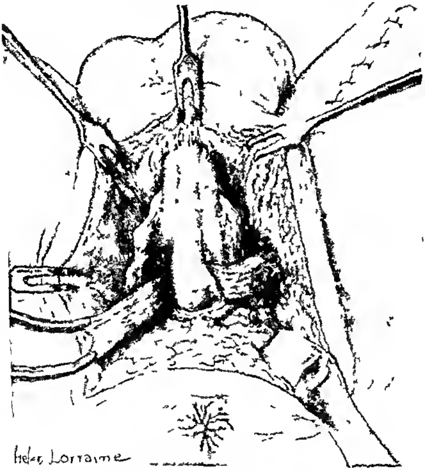

Fig. 664.—Player and Callander's method of applying Deming's operation for incontinence of urine in the female to incontinence in the male. The gracilis muscle has been dissected free and the distal end drawn through a subcutaneous tunnel to the perineum where it is sutured snugly around the bulbous urethra.

divided. The separated anal sphincter is then divided into two parts along the direction of the fibers, the distal area being preserved for anal control. Colles' fascia is then incised and the bulbous urethra is isolated. A rather sizable portion of the urethra is isolated if possible. The portion of the isolated anal sphincter which is to be utilized in the operation is incised as far down on the left as is convenient. It is then drawn around the isolated bulbous urethra, and the cut end secured in its original position by two or more

is to be taken. A median perineal incision is carried from a point just posterior to the root of the scrotum to within about an inch and a half of the anus. The incision is carried through Colles' fascia and exposes the entire portion of the urethra covered by the bulbocavernosus muscle. The superficial structures, including Colles' fascia, are dissected free and widely retracted until the contents of the superficial perineal compartment are exposed. The bulbocavernosus muscle is divided in its median raphe and its symmetrical portions are retracted laterally. The corpus cavernosum of the bulbous urethra and the inferior surface of the urogenital diaphragm are exposed. The corpus cavernosum of the urethra is now carefully separated from the inferior surface of the urogenital diaphragm. This may be accomplished by gently inserting the points of a clamp and spreading them until the urethra is separated from the inferior surface of the urogenital diaphragm from the point at which it emerges from the diaphragm to the point at which it joins the cavernous bodies of the penis.

An incision is then carried over the gracilis muscle from a point about 6 centimeters distal to its origin at the anterior margin of the lower half of the symphysis pubis to the medial condyle of the femur. The incision goes down to the deep fascia which is divided throughout the length of the incision and the muscle is exposed. A branch of the anterior division of the obturator nerve and arterial supply from the obturator artery and the internal circumflex branch of the profunda femoris artery enter the muscle on its dorsal side very close to its origin. The muscle is divided transversely in its tendinous portion, opposite the mesial condyle of the femur, and is dissected up back to the point of entrance of its nerve and blood supply.

A passage for the transplanted muscle is tunneled beneath the skin from the perineal incision to the upper end of the incision in the thigh. The distal end of the gracilis muscle is drawn by clamps through this tunnel and under the bulbous urethra in the space made by dissecting the urethra from the undersurface of the urogenital diaphragm, and is pulled to the estimated proper tension (Fig. 664). It is now sutured to the two corpora of the penis at the points of contact for support, and the free end of the muscle is rolled over the urethra and sutured to itself. Bleeding is carefully controlled and both the incision in the perineum and the incision in the thigh are closed without drainage. The bladder is drained for about a week with a small urethral catheter.

Success in this operation depends upon placing the muscle around the urethra accurately and snugly. If the muscle is applied loosely around the urethra, incontinence will not be relieved.

This operation does not seem physiologic. The gracilis muscle does not have sphincteric properties and cannot be expected to synchronize with the muscular efforts of the bladder. Doubtless the snug application of fascia would serve the same purpose as the transplantation of the gracilis muscle.

Within recent years interest in the use of muscle and fascial slings to produce pressure upon the urethra with the hope of alleviating or controlling incontinence has been revived.

tunnels are joined by finger dissection, the septum is weakened and the subsequent placement of the strips of fascia about the bulb is embarrassed by too large an aperture. When the sling is tightened it will pull away from the posterior aspect of the bulb and will compress the urethra too far anteriorly. Allow at least 3-4 cm. of tissue wall to separate the developed tunnels on either side of the bulb." When the tunnels have been formed, the catgut suture attached to the fascial strip of either the right or the left side is grasped with a long Kelly forceps or attached to an aneurysm needle and is introduced into the tunnel of the same side. The instrument is thrust through the tissue posterior to the bulbocavernosus muscle and the catgut suture grasped by a Kelly forceps that has been passed into the opposite side. Both fascial strips are then brought simultaneously into position from opposite directions.

"As the fascial strips emerge and are pulled superiorly over the pubis and to either side of the penis they are immobilized by suturing them to the rectus fascia. Wire sutures are preferable. The strips of fascia can be incorporated with the closure of the inferior portion of the rectus aponeurosis from which the strips were excised, as described by Cooney and Horton. Alternatively they can be sutured to rectus aponeurosis just mesial to the midline and about 4 cm. above the external ring. In this position the strips are anchored well above Poupart's ligament and in an area where muscular tone transmits tension and flexibility to the strips.

"The amount of tension to place on the fascial sling before it is anchored which will, by its compression of the bulbocavernosus, prevent urethral leakage is a difficult equation and one of the very important steps in the technique. An indwelling catheter should not be placed in the urethra until after fixation of the fascial strips."

The amount of pressure necessary to apply to the strips can be determined by filling the bladder with sterile water and removing the catheter. As an assistant makes pressure suprapubically and expels the water through the incontinent urethra, the strips are pulled upward until the flow of water is controlled. The strips of fascia are adjusted to the rectus fascia at this point. The wound is closed without drainage and a urethral catheter inserted to remain seven days.

Uhle, in a paper read before the Mid-Atlantic Urological Association, reported five patients operated upon by this method, with definite improvement in three. One other patient was operated upon by an associate, using the same technique but utilizing strips of fascia lata. This patient was not improved.

In 1951 Cooney and Horton reported a sling operation similar to the one described by Uhle. Their operation varied in that two parallel abdominal incisions are made and the penis is not suspended. In suturing the wound the ends of the strips of fascia are incorporated in the closure of the lower end of the defect left when the fascial strips are dissected free. They reported excellent results in two of three patients operated upon.

Strong and Van Buskirk have described a method of bringing strips of rectus fascia behind the symphysis and crossing them behind the membranous urethra by a perineal approach with satisfactory results in one case.

sutures of ribbon gut. Before suturing, a No 16 French, soft, rubber catheter must be inserted into the urethra, because catheterization is difficult after the loop has been established.

The wound is closed in layers. Exercises directed at starting and stopping the urinary stream by relaxing and contracting the anus are begun two or three weeks postoperatively, and continued until control of urination is satisfactory.

THE FASCIAL SLING

In October, 1945, Dr. Charles A. W. Uhle utilized strips of rectus fascia for the purpose of compressing the bulbous urethra in the treatment of incontinence The strips were obtained from the aponeurotic coverings of the recti muscles, one from either side of the midline, and carried anterior to the pubis and crossed beneath the bulbous urethra, the end of each strip being brought up and sutured to the rectus fascia of the opposite side.

He advises the following technique. The patient is placed in a modified lithotomy position, giving access to the abdomen and to the perineum for adjustment of the slings if necessary. A midline incision is made from the suspensory ligament of the penis to a point about three centimeters above the umbilicus. The fatty areola tissue is then dissected from the rectus fascia for approximately four centimeters from the midline through the length of the incision. A one-centimeter strip of fascia is excised from both the right and the left side of the incision The mesial border of each strip should be three centimeters from the midline. The length of the strips must be sufficient to pass from above the pubis, beneath the bulbous urethra, and to a similar position on the opposite side. This may be determined by measurement with a length of catgut or tape. The lower ends of the fascial strips are left attached at least three centimeters above the inguinal rings and the attachments reinforced with embricating sutures of fine wire to prevent tearing when tension is introduced

The rectus fascia should be closed with wire If one prefers, the superior halves of the incisions may be closed, leaving the remainder to be closed later, incorporating the ends of the fascial strips after the tension has been set.

The suspensory ligament of the penis is then exposed and shortened by placing four equidistant, longitudinal, chromic catgut sutures in such a manner that when tied the root of the penis will hug the inferior surface of the symphysis. The midline and deeper structures should be avoided, to prevent injury to blood and nerve supply Uhle believes that suspension of the penis in this manner is definitely helpful in urinary control.

"Blunt dissection with the index finger is gently directed over the symphysis to either side of the penis and mesial to the spermatic cords It is carried to the lateral aspects of the bulbous portion of the urethra as close to the urogenital diaphragm as one can work The fibro-fatty tissue in the midline overlying the bulb should not be perforated nor should it be developed from either side to paper thinness. This is a most important step in the technique. If the

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I recently saw Mr. Terrence Millin operate upon a patient for incontinence following a radical perineal prostectomy. He made a short transverse incision above the pubis, exposing the fascia of the recti muscles. A tunnel was made on either side anterior to the pubis and to the perineum as described by Uhle. A short incision was made in the midline of the perineum and by blunt dissection the urethral bulb was exposed on either side. The median raphe and soft tissue posterior to the urethra were not disturbed. A single strip of fascia lata was removed from the external surface of the thigh. One end was threaded through the tunnel on the left and accurately placed behind the urethra near the triangular ligament by penetrating the bridge of perineal tissue that had been left intact. The strip of fascia was then threaded through the opposite tunnel to emerge over the pubis on the right side. The bladder was filled with water and the catheter removed. The anesthesiologist caused the patient to cough, and the ends of the fascial strip were pulled upon until coughing no longer caused water to be expelled from the urethra. The ends were then secured to the rectus fascia on either side. The wound was closed and the patient returned to his room without catheter drainage.

Mr. Millin reports good results from this operation. It is much simpler and less time-consuming than other sling operations.

I have attempted to cure only two patients of incontinence by surgical procedures. In one, a portion of the rectal sphincter was used, and in the other a fascial sling. Neither was cured but both were greatly improved, one being able to return to his occupation, which was impossible before he was operated upon. The other upon whom a sling was used had definitely less dribbling but unfortunately had had a prefrontal lobotomy which made it impossible to obtain cooperation for him.

These operations deserve consideration. Careful technique and attention to detail will certainly improve most of these patients and eventually a method or modification of the above may produce completely satisfactory results

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